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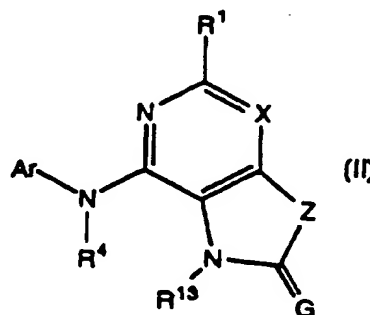
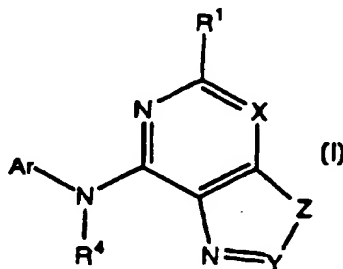
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(54) Title: ARYLAMINO FUSED PYRIDINES AND PYRIMIDINES

(57) Abstract

Corticotropin releasing factor (CRF) antagonists of formula (I) or formula (II); and their use in treating anxiety, depression, and other psychiatric and neurological disorders.



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TITLE

ARYLAMINO FUSED PYRIDINES AND PYRIMIDINES

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FIELD OF THE INVENTION

This invention relates to novel compounds and pharmaceutical compositions, and to methods of using same in the treatment of psychiatric disorders and neurological diseases including major depression, anxiety-related disorders, post-traumatic stress disorder, supranuclear palsy and feeding disorders.

BACKGROUND OF THE INVENTION

15 Corticotropin releasing factor (herein referred to as CRF), a 41 amino acid peptide, is the primary physiological regulator of proopiomelanocortin (POMC)-derived peptide secretion from the anterior pituitary gland [J. Rivier et al., *Proc. Nat. Acad. Sci. (USA)* 80:4851 (1983); W. Vale et al., *Science* 213:1394 (1981)]. In addition to its endocrine role at the pituitary gland, immunohistochemical localization of CRF has demonstrated that the hormone has a broad extrahypothalamic distribution in the central nervous system and produces a wide spectrum of autonomic, electrophysiological and behavioral effects consistent with a neurotransmitter or neuromodulator role in brain [W. Vale et al., *Rec. Prog. Horm. Res.* 39:245 (1983); G.F. Koob, *Persp. Behav. Med.* 2:39 (1985); E.B. De Souza et al., *J. Neurosci.* 5:3189 (1985)]. There is also evidence that CRF plays a significant role in integrating the response of the immune system to physiological, psychological, and immunological stressors [J.E. Blalock, *Physiological Reviews* 69:1 (1989); J.E. Morley, *Life Sci.* 41:527 (1987)].

Clinical data provide evidence that CRF has a role in psychiatric disorders and neurological diseases including depression, anxiety-related disorders and feeding disorders. A role for CRF has also been postulated in the etiology and pathophysiology of Alzheimer's disease, Parkinson's disease, Huntington's disease, progressive supranuclear palsy and amyotrophic lateral sclerosis as they relate to the dysfunction of CRF neurons in the central nervous system [for review see E.B. De Souza, *Hosp. Practice* 23:59 (1988)].

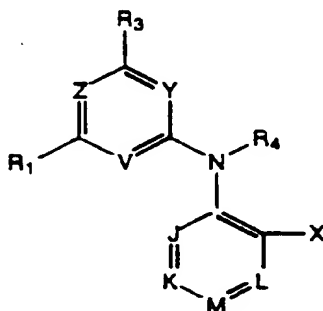
In affective disorder, or major depression, the concentration of CRF is significantly increased in the cerebral spinal fluid (CSF) of drug-free individuals [C.B. Nemeroff et al., *Science* 226:1342 (1984); C.M. Banki et al., *Am. J. Psychiatry* 144:873 (1987); R.D. France et al., *Biol. Psychiatry* 28:86 (1988); M. Arato et al., *Biol Psychiatry* 25:355 (1989)]. Furthermore, the density of CRF receptors is significantly decreased in the frontal cortex of suicide victims, consistent with a hypersecretion of CRF [C.B. Nemeroff et al., *Arch. Gen. Psychiatry* 45:577 (1988)]. In addition, there is a blunted adrenocorticotropin (ACTH) response to CRF (i.v. administered) observed in depressed patients [P.W. Gold et al., *Am J. Psychiatry* 141:619 (1984); F. Holsboer et al., *Psychoneuroendocrinology* 9:147 (1984); P.W. Gold et al., *New Eng. J. Med.* 314:1129 (1986)]. Preclinical studies in rats and non-human primates provide additional support for the hypothesis that hypersecretion of CRF may be involved in the symptoms seen in human depression [R.M. Sapolsky, *Arch. Gen. Psychiatry* 46:1047 (1989)]. There is preliminary evidence that tricyclic antidepressants can alter CRF levels and thus modulate the numbers of CRF receptors in brain

[Grigoriadis et al., *Neuropsychopharmacology* 2:53 (1989)].

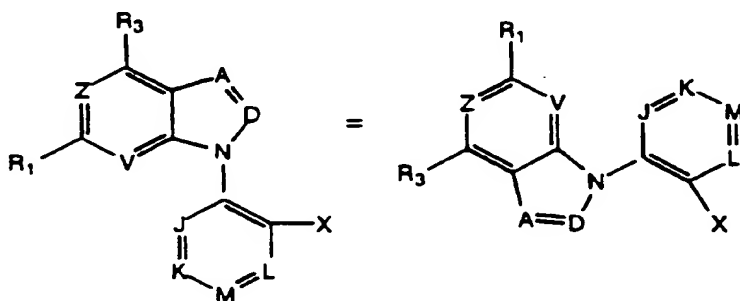
- There has also been a role postulated for CRF in the etiology of anxiety-related disorders. CRF produces anxiogenic effects in animals and interactions between benzodiazepine / non-benzodiazepine anxiolytics and CRF have been demonstrated in a variety of behavioral anxiety models [D.R. Britton et al., *Life Sci.* 31:363 (1982); C.W. Berridge and A.J. Dunn *Regul. Peptides* 16:83 (1986)]. Preliminary studies using the putative CRF receptor antagonist α -helical ovine CRF (9-41) in a variety of behavioral paradigms demonstrate that the antagonist produces "anxiolytic-like" effects that are qualitatively similar to the benzodiazepines [C.W. Berridge and A.J. Dunn *Horm. Behav.* 21:393 (1987), *Brain Research Reviews* 15:71 (1990)]. Neurochemical, endocrine and receptor binding studies have all demonstrated interactions between CRF and benzodiazepine anxiolytics providing further evidence for the involvement of CRF in these disorders. Chlordiazepoxide attenuates the "anxiogenic" effects of CRF in both the conflict test [K.T. Britton et al., *Psychopharmacology* 86:170 (1985); K.T. Britton et al., *Psychopharmacology* 94:306 (1988)] and in the acoustic startle test [N.R. Swerdlow et al., *Psychopharmacology* 88:147 (1986)] in rats. The benzodiazepine receptor antagonist (Ro15-1788), which was without behavioral activity alone in the operant conflict test, reversed the effects of CRF in a dose-dependent manner while the benzodiazepine inverse agonist (FG7142) enhanced the actions of CRF [K.T. Britton et al., *Psychopharmacology* 94:306 (1988)].
- The mechanisms and sites of action through which the standard anxiolytics and antidepressants produce their therapeutic effects remain to be elucidated. It has been hypothesized however, that they are

involved in the suppression of the CRF hypersecretion that is observed in these disorders. Of particular interest is that preliminary studies examining the effects of a CRF receptor antagonist (α -helical CRF₉₋₄₁) in a variety of behavioral paradigms have demonstrated that the CRF antagonist produces "anxiolytic-like" effects qualitatively similar to the benzodiazepines [for review see G.F. Koob and K.T. Britton, In: *Corticotropin-Releasing Factor: Basic and Clinical Studies of a Neuropeptide*, E.B. De Souza and C.B. Nemeroff eds., CRC Press p221 (1990)].

DuPont Merck PCT application US94/11050 describes corticotropin releasing factor antagonist compounds of the formula:



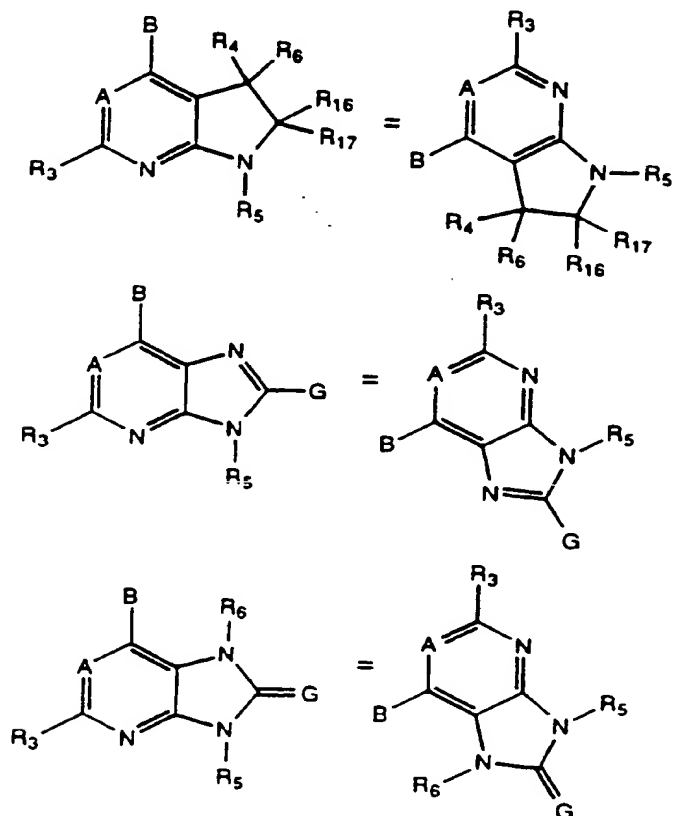
and their use to treat psychiatric disorders and neurological diseases. Included in the description are fused pyridines and pyrimidines of the formula:



where: V is CR^{1a} or N; Z is CR² or N; A is CR³⁰ or N; and D is CR²⁸ or N.

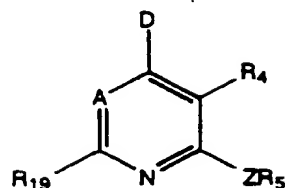
Pfizer WO 95/33750 describes corticotropin releasing factor antagonist compounds useful in the treatment of CNS and stress disorders. The description includes compounds of the formulae:

5



where A is CR₇ or N; B is -NR₁R₂; R₁ is substituted or unsubstituted alkyl; R₂ is substituted or unsubstituted alkyl, aryl or heteroaryl; R₃ is methyl, halo, cyano, methoxy, etc.; R₄ is H, substituted or unsubstituted alkyl, halo, amino, nitro, etc.; R₅ is substituted or unsubstituted aryl or heteroaryl; R₆ is H or substituted or unsubstituted alkyl; R₇ is H, methyl, halo, cyano, etc.; R₁₆ and R₁₇ taken together form an oxo (=O) group; and G is =O, =S, =NH, =NCH₃, hydrogen,

methyl, methoxy, etc. Pfizer WO 95/33750 also describes intermediates of the formula:

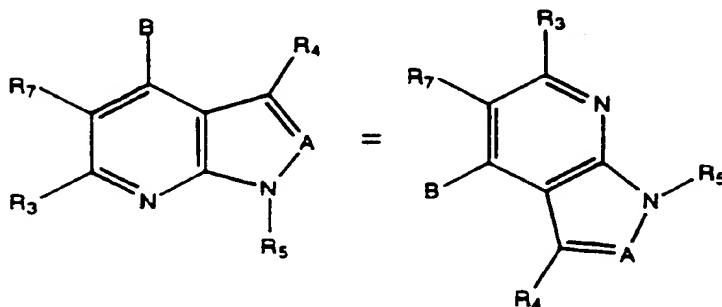


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where A can be N, D can be OH, R₄ can be nitro, R₁₉ is methyl or ethyl, Z can be NH or N(CH₃), and R₅ is substituted phenyl or substituted pyridyl, each substituted with 2 or 3 substituents selected from C1-C4 alkyl, chloro and bromo.

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Pfizer WO 95/34563 describes corticotropin releasing factor antagonist compounds, including compounds of the formula:

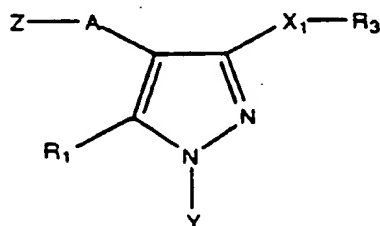


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where A, B and the R groups have definitions similar to those in WO 95/33750.

Pfizer WO 95/33727 describes corticotropin releasing factor antagonist compounds of the formula:

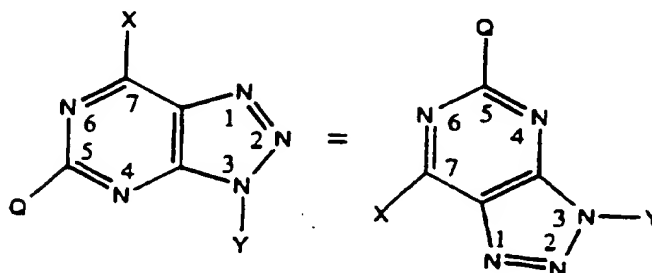
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where A is CH₂ and Z can be a heteroaryl moiety.

Ganguly et al., U.S. Patent 4,076,711 describes triazolo[4,5-d]pyrimidines of the formula:

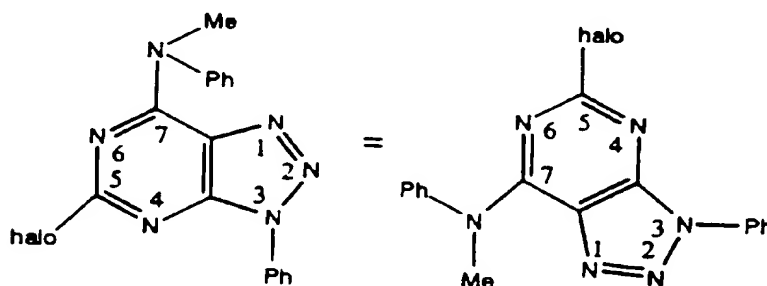
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where X is halo, -NR₁R or alkoxy, with R₁ and R each being H or alkyl; Y is alkyl, cycloalkyl,

10 hydroxycycloalkyl, phenyl, bicycloalkyl or phenylalkyl or bicycloalkylalkyl; and Q is H or Y. The patent states that the compounds are useful in the treatment of psoriasis.

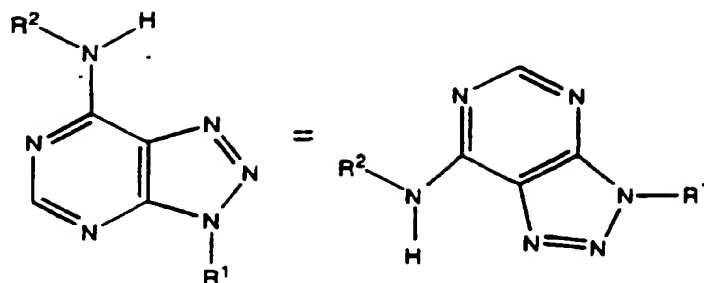
15 Tanji et al., Chem. Pharm. Bull. 39(11)3037-3040(1991), describes triazolo[4,5-d]pyrimidines of the formula:



20 where halo is I, Br or Cl, Ph is phenyl and Me is methyl. No utility for the compounds is described.

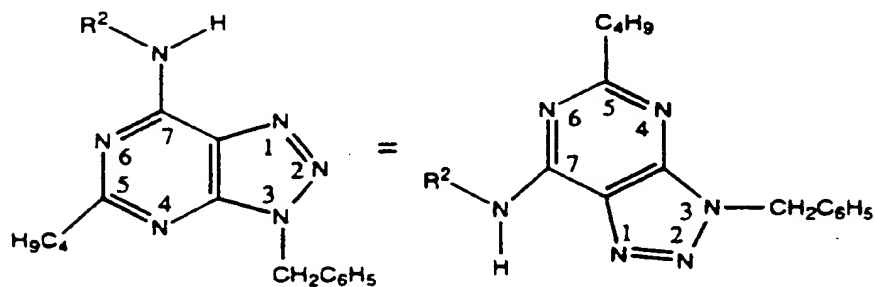
Settimo et al., Il Farmaco, Ed. Sc., 35 (4), 308-323 (1980) describes 8-azaadenines (triazolo[4,5-d]pyrimidines) of the formula:

25



where R1 is H or benzyl and R2 is p-methylphenyl.

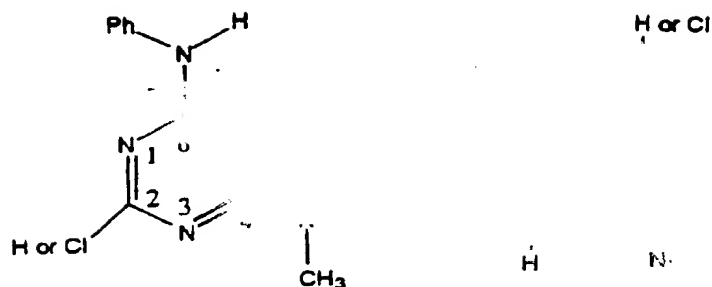
- 5 Biagi et al., *Il Farmaco*, 49 (3), 183-186 (1994), describes N(6)-substituted 2-n-butyl-9-benzyl-8-azaadenines of the formula:



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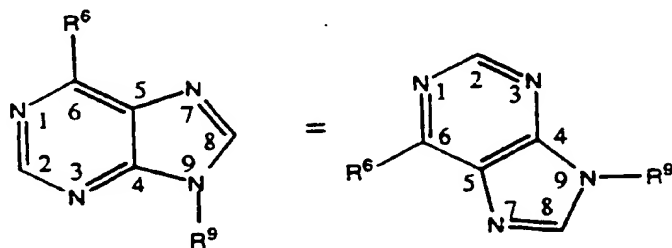
where R² can be alkyl, phenyl, or benzyl. The paper states that the compounds have affinity for adenosine receptors.

- 15 Thompson et al., *J. Med. Chem.*, 1991, 34, 2877-2882, describes N⁶,9-disubstituted adenines of the formula:



where Ph is phenyl or (when C-2 is unsubstituted) 2-fluorophenyl. The paper states that the compounds have
 5 selective affinity for the A₁ adenosine receptor.

Kelley et al., J. Med. Chem. 1990, 31, 606-612,
 describes the compound

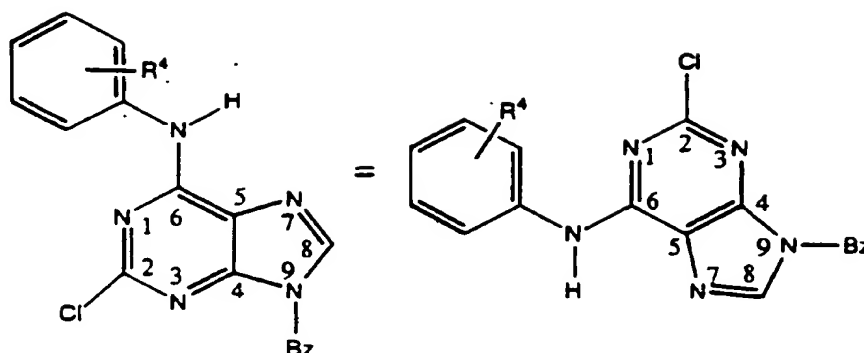


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where R⁶ is NHC₆H₅ and R⁹ is CH₂C₆H₅, and reports that
 the compound was inactive when tested for anticonvulsant
 activity. The paper reports that various 6-
 15 (alkylamino)-9-benzyl-9H-purine analogs of the above
 compound exhibited anticonvulsant activity.

Kelley et al., J. Med. Chem. 1990, 33, 1360-1363,
 describes 6-anilino-9-benzyl-2-chloro-9H-purines of the
 formula:

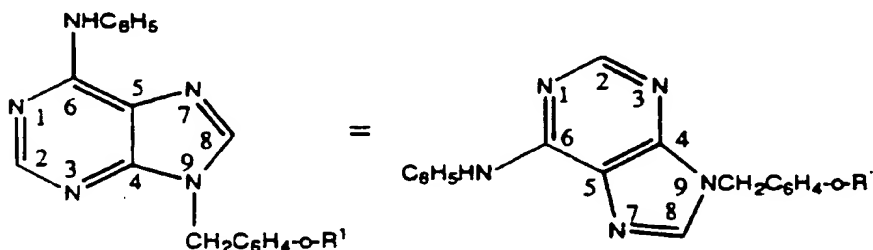
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where Bz is benzyl or (when R⁴ is H) p-methylbenzyl and R⁴ is H or alkyl, alkoxy, halo, cyano, nitro, etc.

- 5 Tests of the compounds for antirhinoviral activity are reported.

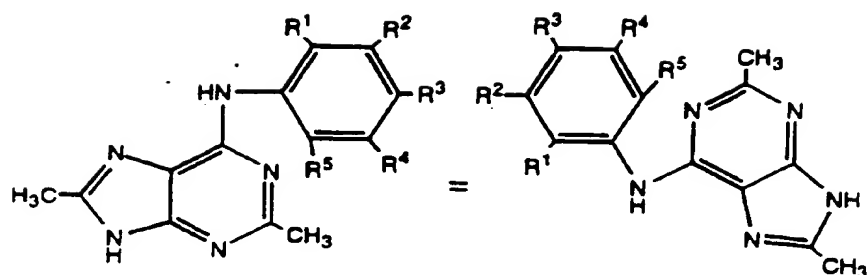
Kelley et al., J. Heterocyclic Chem., 28, 1099 (1991), describes 6-substituted-9-(3-formamidobenzyl)-9H-purines of the formula:



where R₁ is NH₂ or NHCHO. The compound where R₁ is NHCHO was tested for benzodiazepine receptor binding and was inactive, although various analogs were active.

Khairy et al., J. Heterocyclic Chem., 22, 853 (1985), describes synthesis of certain 9-aryl-9H-purin-6-amines of the formula:

20

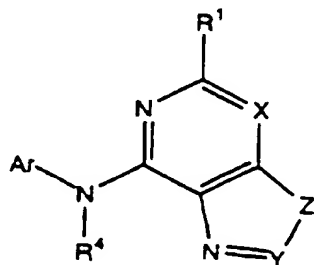


where the R groups are H, methyl, ethyl, isopropyl, chloro or fluoro.

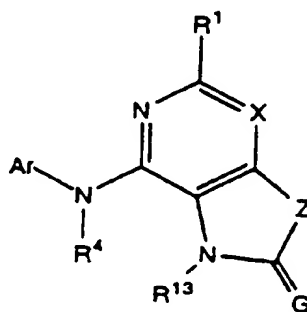
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SUMMARY OF THE INVENTION

This invention is a class of novel compounds which are CRF receptor antagonists and which can be represented by formula I or formula II:



I



II

15

or a pharmaceutically acceptable salt or pro-drug form thereof, wherein:

X is N or CR¹;

20

Y is N or CR²;

Z is NR³, C, or S(O)_n;

G is O or S;

- Ar is phenyl, naphthyl, pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl or pyrazolyl, each optionally substituted with 1 to 5 R⁵ groups;
- 10 R¹ is independently at each occurrence H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;
- 15 R² is H, C₁-C₄ alkyl, C₁-C₆ cycloalkyl, halo, CN, -NR⁶R⁷, NR⁹COR¹⁰, C₁-C₄ haloalkyl, -OR⁷, SH or -S(O)_nR¹²;
- 20 R³ is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, -CONR⁶R⁷, aryl, heteroaryl and heterocyclyl, where the aryl, heteroaryl or heterocyclyl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- 35

- 5 R^4 is H, C₁-C₄ alkyl, allyl, or propargyl, where
 C₁-C₄ alkyl, allyl, or propargyl is optionally
 substituted with C₃-C₆ cycloalkyl and where
 C₁-C₄ alkyl is optionally substituted with,
 -OR⁷, -S(O)_nR¹² or -CO₂R⁷;
- 10 R^5 is independently at each occurrence C₁-C₁₀ alkyl,
 C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆
 cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo,
 -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷,
 -COR⁷ -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or
 -S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl,
 C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-
 C₁₂ cycloalkylalkyl are optionally substituted
 15 with 1 to 3 substituents independently selected
 at each occurrence from C₁-C₄ alkyl, -NO₂, halo,
 -CN, -NR⁶R⁷, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷
 -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;
- 20 R^6 and R^7 are independently at each occurrence H,
 C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl,
 C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl,
 aryl(C₁-C₄ alkyl)-, heteroaryl or
 heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is
 25 piperidine, pyrrolidine, piperazine, N-
 methylpiperazine, morpholine or thiomorpholine;
- R^8 is independently at each occurrence H or C₁-C₄
 alkyl;
- 30 R^9 and R^{10} are independently at each occurrence
 selected from H, C₁-C₄ alkyl, or C₃-C₆
 cycloalkyl;
- 35 R^{11} is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or
 C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈
alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-

5 C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-,
heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

aryl is phenyl or naphthyl, each optionally
substituted with 1 to 3 substituents

10 independently selected at each occurrence from
C₁-C₅ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
-NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

15

heteroaryl is pyridyl, pyrimidinyl, triazinyl,
furanyl, quinolinyl, isoquinolinyl, thienyl,
imidazolyl, thiazolyl, indolyl, pyrrolyl,
oxazolyl, benzofuranyl, benzothienyl,

20 benzthiazolyl, isoxazolyl, pyrazolyl,
triazolyl, tetrazolyl, or indazolyl, each
optionally substituted with 1 to 3 substituents
independently selected at each occurrence from
C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
25 C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
-NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

heterocyclyl is saturated or partially saturated
30 heteroaryl, optionally substituted with 1 to 3
substituents independently selected at each
occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl,
halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH,
-S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷,
35 -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and
-CONR⁶R⁷;

n is independently at each occurrence 0, 1 or 2;

provided that R⁴ in formula I is not H:

- (a) when X is N, Y is N, Z is NR³, R¹ is H, R³ is
5 H or benzyl, and Ar is p-methylphenyl;
- (b) when X is N, Y is N, Z is NR³, R¹ is butyl, R³
is benzyl, and Ar is phenyl;
- (c) when X is N, Y is CH, Z is NR³, R³ is methyl,
R¹ is H, and Ar is phenyl or 2-fluorophenyl;
- 10 (d) when X is N, Y is CH, Z is NR³, R³ is methyl,
R¹ is Cl and Ar is phenyl;
- (e) when X is N, Y is CH, Z is NR³, R¹ is Cl, R³
is benzyl, and Ar is phenyl or substituted phenyl;
- (f) when X is N, Y is CH, Z is NR³, R³ is p-
15 methylbenzyl, and Ar is phenyl;
- (g) when X is N, Y is CR², Z is NR³, R² is CH₃, R³
is H, and Ar is phenyl or phenyl substituted with
methyl, ethyl, isopropyl, fluoro or chloro;
- (h) when X is N, Y is N, Z is NR³, R³ is
20 cyclopropylmethyl, R¹ is H, and Ar is 2-bromo-4-
isopropylphenyl, or
- (i) when X is N, Y is N, Z is S, R¹ is H, and Ar
is 2-bromo-4-isopropylphenyl.

25 Preferred compounds of this invention are compounds
of formula I and formula II and pharmaceutically
acceptable salts and pro-drug forms thereof, wherein,
independently or concurrently:

30 X is N or CR¹;

Y is N or CR²;

Z is NR³, O, or S(O)_n;

35

G is O or S;

Ar is phenyl or pyridyl, each optionally substituted with 1 to 3 R^5 groups;

5 R^1 is independently at each occurrence H, C_1 - C_4 alkyl, halo, CN, C_1 - C_4 haloalkyl, $-NR^9R^{10}$, $-OR^{11}$ or $-S(O)_nR^{12}$;

R^2 is H, C_1 - C_4 alkyl, C_1 - C_6 cycloalkyl, halo, CN, $-NR^6R^7$, NR^9COR^{10} , C_1 - C_4 haloalkyl, $-OR^7$ or $-S(O)_nR^{12}$;

10

R^3 is H, C_1 - C_{10} alkyl, C_2 - C_{10} alkenyl, C_2 - C_{10} alkynyl, C_3 - C_8 cycloalkyl or C_4 - C_{12} cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C_1 - C_6 alkyl, C_3 - C_6 cycloalkyl, halo, C_1 - C_4 haloalkyl, cyano, $-OR^7$, $-S(O)_nR^{13}$, $-CO_2R^7$, $-NR^8COR^7$, $-NR^8CONR^6R^7$, $-NR^8CO_2R^{13}$, $-NR^6R^7$, aryl and heteroaryl, where the aryl or heteroaryl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C_1 - C_4 alkyl, halo, cyano, $-OR^7$, $-S(O)_nR^7$, $-CO_2R^7$, $-NR^8COR^7$, $-NR^8CONR^6R^7$, $-NR^8CO_2R^7$, and $-NR^6R^7$;

15

20

R^4 is H, C_1 - C_4 alkyl, allyl, or propargyl;

25

R^5 is independently at each occurrence C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_3 - C_6 cycloalkyl, C_4 - C_8 cycloalkylalkyl, $-NO_2$, halo, $-CN$, C_1 - C_4 haloalkyl, $-NR^6R^7$, COR^7 , $-OR^7$, $-CONR^6R^7$, $-CO(NOR^9)R^7$, CO_2R^7 , or $-S(O)_nR^7$, where C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_3 - C_6 cycloalkyl and C_4 - C_{12} cycloalkylalkyl are optionally substituted with 1 to 3 substituents independently selected at each occurrence from C_1 - C_4 alkyl, $-NO_2$, halo, $-CN$, $-NR^6R^7$, COR^7 , $-OR^7$, $-CONR^6R^7$, CO_2R^7 , $-CO(NOR^9)R^7$, or $-S(O)_nR^7$;

30

35

- 5 R^6 and R^7 are independently at each occurrence H, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_2 - C_8 alkoxyalkyl, C_3 - C_6 cycloalkyl, C_4 - C_{12} cycloalkylalkyl, aryl, aryl(C_1 - C_4 alkyl)-, heteroaryl or heteroaryl(C_1 - C_4 alkyl)-; or NR^6R^7 is piperidine, pyrrolidine, piperazine, N-methylpiperazine, morpholine or thiomorpholine;
- 10 R^8 is independently at each occurrence H or C_1 - C_4 alkyl;
- R^9 and R^{10} are independently at each occurrence selected from H, C_1 - C_4 alkyl, or C_3 - C_6 cycloalkyl;
- 15 R^{11} is H, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, or C_3 - C_6 cycloalkyl;
- R^{12} is C_1 - C_4 alkyl or C_1 - C_4 haloalkyl;
- 20 R^{13} C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_2 - C_8 alkoxyalkyl, C_3 - C_6 cycloalkyl, C_4 - C_{12} cycloalkylalkyl, aryl, aryl(C_1 - C_4 alkyl)-, heteroaryl or heteroaryl(C_1 - C_4 alkyl)-;
- 25 aryl is phenyl or naphthyl optionally substituted with 1 to 3 substituents independently selected at each occurrence from C_1 - C_4 alkyl, halo, cyano, $-OR^7$, $-S(O)_nR^{12}$, $-CO_2R^8$, $-NR^8COR^7$, $-NR^8CONR^6R^7$, $-NR^8CO_2R^{12}$, and $-NR^6R^7$;
- 30 heteroaryl is pyridyl, pyrimidinyl, triazinyl, furanyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, isoxazolyl, pyrazolyl, triazolyl, tetrazolyl, or indazolyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C_1 - C_4 alkyl, halo, cyano, $-OR^7$, $-S(O)_nR^{12}$, $-CO_2R^8$, $-NR^8COR^7$, $-NR^8CONR^6R^7$, $-NR^8CO_2R^{12}$, and $-NR^6R^7$;
- 35

n is independently at each occurrence 0, 1 or 2.

Of the preferred compounds, more preferred are
5 those of formula I wherein Z is NR^3 and
pharmaceutically acceptable salts and pro-drug forms
thereof.

Included in this invention is the method of
10 treating affective disorder, anxiety, depression,
irritable bowel syndrome, post-traumatic stress
disorder, supranuclear palsy, immune suppression,
Alzheimer's disease, gastrointestinal disease,
anorexia nervosa or other feeding disorder, drug or
15 alcohol withdrawal symptoms, drug addiction,
inflammatory disorder, or fertility problem in a
mammal comprising administering to the mammal a
therapeutically effective amount of a compound of
formula I or II.

20 Also included in this invention are
pharmaceutical compositions comprising a
pharmaceutically acceptable carrier and a
therapeutically effective amount of any one of the
25 above-described compounds.

This invention also includes intermediate
compounds useful in preparation of the CRF antagonist
compounds and processes for making those
30 intermediates, as described in the following
description and claims.

The CRF antagonist compounds provided by this
invention (and especially labelled compounds of this
35 invention) are also useful as standards and reagents
in determining the ability of a potential
pharmaceutical to bind to the CRF receptor.

DETAILED DESCRIPTION OF INVENTION

Many compounds of this invention have one or more
5 asymmetric centers or planes. Unless otherwise
indicated, all chiral (enantiomeric and diastereomeric)
and racemic forms are included in the present invention.
Many geometric isomers of olefins, C=N double bonds, and
the like can also be present in the compounds, and all
10 such stable isomers are contemplated in the present
invention. The compounds may be isolated in optically
active or racemic forms. It is well known in the art
how to prepare optically active forms, such as by
resolution of racemic forms or by synthesis from
15 optically active starting materials. All chiral,
(enantiomeric and diastereomeric) and racemic forms and
all geometric isomeric forms of a structure are
intended, unless the specific stereochemistry or isomer
form is specifically indicated.

20 The term "alkyl" includes both branched and
straight-chain alkyl having the specified number of
carbon atoms. "Alkenyl" includes hydrocarbon chains
of either a straight or branched configuration and
one or more unsaturated carbon-carbon bonds which may
25 occur in any stable point along the chain, such as
ethenyl, propenyl, and the like. "Alkynyl" includes
hydrocarbon chains of either a straight or branched
configuration and one or more triple carbon-carbon
bonds which may occur in any stable point along the
30 chain, such as ethynyl, propynyl and the like.
"Haloalkyl" is intended to include both branched and
straight-chain alkyl having the specified number of
carbon atoms, substituted with 1 or more halogen;
"alkoxy" represents an alkyl group of indicated
35 number of carbon atoms attached through an oxygen
bridge; "cycloalkyl" is intended to include saturated
ring groups, including mono-, bi- or poly-cyclic ring

systems, such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, and so forth. "Halo" or "halogen" includes fluoro, chloro, bromo, and iodo.

The term "substituted", as used herein, means
5 that one or more hydrogen on the designated atom is replaced with a selection from the indicated group, provided that the designated atom's normal valency is not exceeded, and that the substitution results in a stable compound. When a substituent is keto (i.e.,
10 =O), then 2 hydrogens on the atom are replaced.

Combinations of substituents and/or variables are permissible only if such combinations result in stable compounds. By "stable compound" or "stable structure" is meant a compound that is sufficiently
15 robust to survive isolation to a useful degree of purity from a reaction mixture, and formulation into an efficacious therapeutic agent.

The term "appropriate amino acid protecting group" means any group known in the art of organic
20 synthesis for the protection of amine or carboxylic acid groups. Such amine protecting groups include those listed in Greene and Wuts, "Protective Groups in Organic Synthesis" John Wiley & Sons, New York (1991) and "The Peptides: Analysis, Synthesis,
25 Biology, Vol. 3, Academic Press, New York (1981), the disclosure of which is hereby incorporated by reference. Any amine protecting group known in the art can be used. Examples of amine protecting groups include, but are not limited to, the following: 1)
30 acyl types such as formyl, trifluoroacetyl, phthalyl, and p-toluenesulfonyl; 2) aromatic carbamate types such as benzyloxycarbonyl (Cbz) and substituted benzyloxycarbonyls, 1-(p-biphenyl)-1-methylethoxycarbonyl, and
35 9-fluorenylmethyloxycarbonyl (Fmoc); 3) aliphatic carbamate types such as tert-butyloxycarbonyl (Boc), ethoxycarbonyl, diisopropylmethoxycarbonyl, and

allyloxycarbonyl; 4) cyclic alkyl carbamate types such as cyclopentyloxycarbonyl and adamantyloxycarbonyl; 5) alkyl types such as triphenylmethyl and benzyl; 6) trialkylsilane such as trimethylsilane; and 7) thiol containing types such as phenylthiocarbonyl and dithiasuccinoyl.

The term "amino acid" as used herein means an organic compound containing both a basic amino group and an acidic carboxyl group. Included within this term are natural amino acids, modified and unusual amino acids, as well as amino acids which are known to occur biologically in free or combined form but usually do not occur in proteins. Included within this term are modified and unusual amino acids, such as those disclosed in, for example, Roberts and Vellaccio (1983) The Peptides, 5: 342-429, the teaching of which is hereby incorporated by reference. Modified or unusual amino acids which can be used to practice the invention include, but are not limited to, D-amino acids, hydroxylysine, 4-hydroxyproline, an N-Cbz-protected amino acid, ornithine, 2,4-diaminobutyric acid, homoarginine, norleucine, N-methylaminobutyric acid, naphthylalanine, phenylglycine, β -phenylproline, tert-leucine, 4-aminocyclohexylalanine, N-methyl-norleucine, 3,4-dehydroproline, N,N-dimethylaminoglycine, N-methylaminoglycine, 4-aminopiperidine-4-carboxylic acid, 6-aminocaproic acid, trans-4-(aminomethyl)-cyclohexanecarboxylic acid, 2-, 3-, and 4-(aminomethyl)-benzoic acid, 1-aminocyclopentanecarboxylic acid, 1-aminocyclopropanecarboxylic acid, and 2-benzyl-5-aminopentanoic acid.

The term "amino acid residue" as used herein means that portion of an amino acid (as defined herein) that is present in a peptide.

The term "peptide" as used herein means a compound that consists of two or more amino acids (as defined herein) that are linked by means of a peptide bond. The term "peptide" also includes compounds
5 containing both peptide and non-peptide components, such as pseudopeptide or peptide mimetic residues or other non-amino acid components. Such a compound containing both peptide and non-peptide components may also be referred to as a "peptide analog".

10 The term "peptide bond" means a covalent amide linkage formed by loss of a molecule of water between the carboxyl group of one amino acid and the amino group of a second amino acid.

The term "pharmaceutically acceptable salts"
15 includes acid or base salts of the compounds of formulas (I) and (II). Examples of pharmaceutically acceptable salts include, but are not limited to, mineral or organic acid salts of basic residues such as amines; alkali or organic salts of acidic residues
20 such as carboxylic acids; and the like.

Pharmaceutically acceptable salts of the compounds of the invention can be prepared by reacting the free acid or base forms of these compounds with a stoichiometric amount of the
25 appropriate base or acid in water or in an organic solvent, or in a mixture of the two; generally, nonaqueous media like ether, ethyl acetate, ethanol, isopropanol, or acetonitrile are preferred. Lists of suitable salts are found in Remington's
30 Pharmaceutical Sciences, 17th ed., Mack Publishing Company, Easton, PA, 1985, p. 1418, the disclosure of which is hereby incorporated by reference.

"Prodrugs" are considered to be any covalently bonded carriers which release the active parent drug
35 of formula (I) or (II) *in vivo* when such prodrug is administered to a mammalian subject. Prodrugs of the compounds of formula (I) and (II) are prepared by

modifying functional groups present in the compounds in such a way that the modifications are cleaved, either in routine manipulation or *in vivo*, to the parent compounds. Prodrugs include compounds wherein
5 hydroxy, amine, or sulfhydryl groups are bonded to any group that, when administered to a mammalian subject, cleaves to form a free hydroxyl, amino, or sulfhydryl group, respectively. Examples of prodrugs include, but are not limited to, acetate, formate and
10 benzoate derivatives of alcohol and amine functional groups in the compounds of formulas (I) and (II); and the like.

The term "therapeutically effective amount" of a compound of this invention means an amount effective
15 to antagonize abnormal level of CRF or treat the symptoms of affective disorder, anxiety or depression in a host.

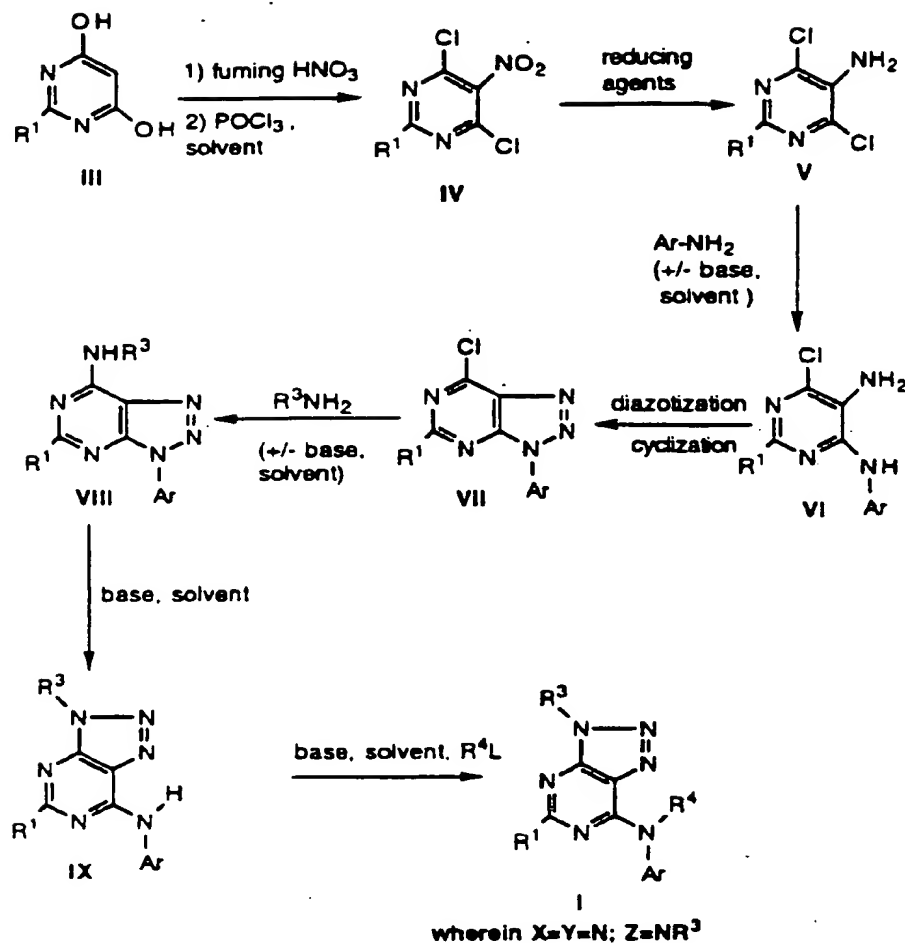
Synthesis

20

The bicyclic fused pyrimidine and pyridines of this invention can be prepared by one of the general schemes outlined below (Scheme 1-9).

Compounds of the Formula (I) wherein $X=Y=N$ and
25 $Z=NR^3$, can be prepared as shown in Scheme 1.

Scheme 1



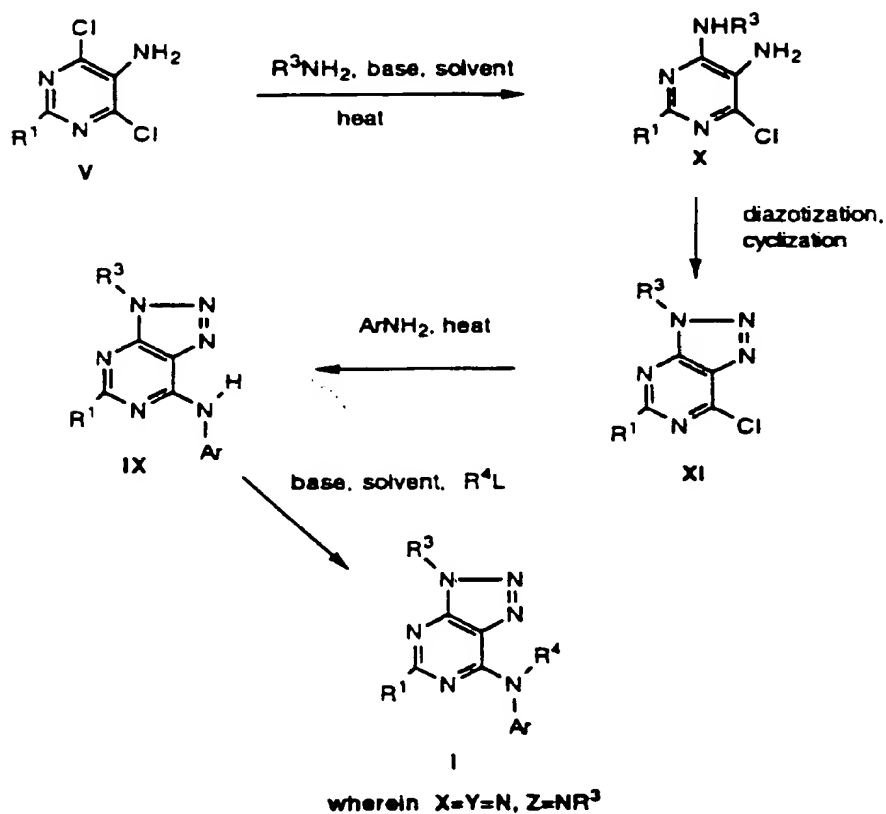
The 4,6-dihydroxypyrimidines (III) can be nitrated using fuming nitric acid and then converted into intermediates (IV) by the action of phosphorous oxychloride with the optional assistance of a catalyst such as dialkylanilines (see: Brown, D.J. et.al. J. Chem. Soc., 1954, 3832). The amino group of pyrimidines of Formula (V) can be prepared from the corresponding nitro compounds (IV) by treatment with reducing agents such as, but not limited to, sodium dithionate, iron or zinc, or catalytic hydrogenation

- (see: Larock, R.C. *Comprehensive Organic Transformations*, VCH Publishers, New York, 1989, 411). Reaction with Ar-NH₂ can be used to provide compounds of Formula (VI). Conditions which may
- 5 facilitate this transformation include the optional presence of protic or aprotic acids, or bases such as alkali metal hydrides, trialkylamines, or alkali metal carbonates, or alkali metal bis(trimethylsilyl)amides wherein the metal can be sodium, lithium, or
- 10 potassium. These reactions may be conducted neat, or in the optional presence of solvents such as but not limited to cyclic ethers such as tetrahydrofuran, dialkylformamides, ethylene glycol, 2-ethoxyethanol, halocarbons, alkanenitriles, or alkyl alcohols at room
- 15 temperature or at elevated temperature up to the boiling point of the solvent employed. One skilled in the art of organic synthesis will readily understand the optimal combinations of these conversions to prepare a number of compounds of Formula (VI).
- 20 Cyclization to triazolopyrimidines of Formula (VII) can then be readily accomplished by diazotization and cyclization of the diamino compounds of Formula (VI) with an alkali metal nitrite in the presence of acid in water with or without an organic cosolvent such as
- 25 halocarbons, or cyclic ethers. Treatment of compound of Formula (VII) with primary amines then can provide the intermediates (VIII) using reaction conditions similar to those employed for the conversion of (V) to (VI). The rearranged triazolopyrimidine of Formula
- 30 (IX) may be obtained from the triazolopyrimidine of Formula (VIII) by treatment with base such as but not limited to, alkali metal hydrides, alkaline earth metal hydrides, alkali metal dialkyl amides in inert solvents such as dialkylformamides, dialkylacetamides
- 35 at temperatures ranging from 0 ° to 200 °C. Finally, reaction with an appropriate R⁴L wherein L is a suitable leaving group such as halo, methanesulfonate,

p-toluenesulfonate, or triflate in the presence or absence of bases such as but not limited to, alkali metal hydrides, alkaline earth metal hydrides, alkali metal dialkyl amides in inert solvents such as dialkylformamides or dialkylacetamides at temperatures ranging from 0 ° to 200 °C can be used to generate compounds of Formula (I).

Alternatively, compounds of Formula (I) wherein $X=Y=N$ and $Z=NR^3$, of this invention can be prepared as outlined in Scheme 2:

Scheme 2

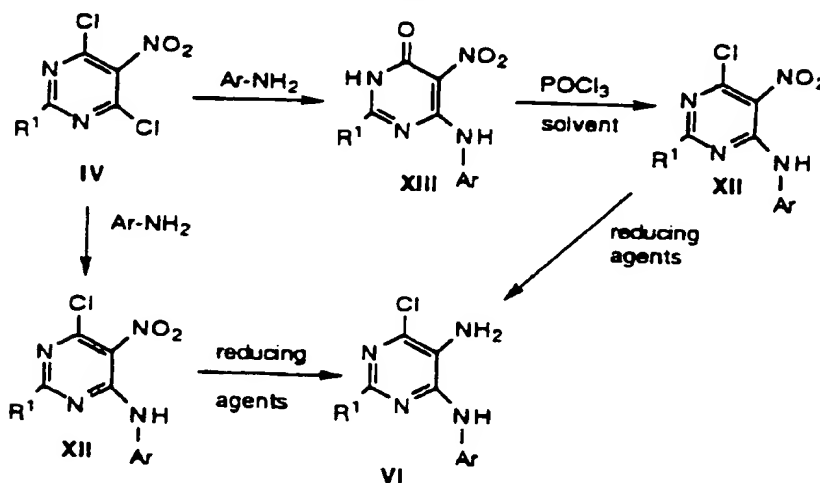


15 Treatment of compound of Formula (V) with primary amines can provide the diamino substituted pyrimidines

(X). Conditions which facilitate this transformation are detailed previously for the conversion of (VII) to (VIII). Cyclization to triazolopyrimidines of Formula (XI) can then be readily accomplished by following the conditions already described for the conversion of (VI) to (VII) in Scheme 1. The leaving group such as, but not limited to, halogen can then be displaced by addition of Ar-NH₂ to provide compounds of Formula (IX) by utilizing the conditions described for the conversion of (V) to (VI). Compounds of Formula (IX) can be converted to (I) in the same way as outlined in Scheme 1.

Compounds of the Formula (VI) can also prepared by an another approach (Scheme 3) involving addition of Ar-NH₂ to (IV) to afford compounds of Formula (XII).

Scheme 3

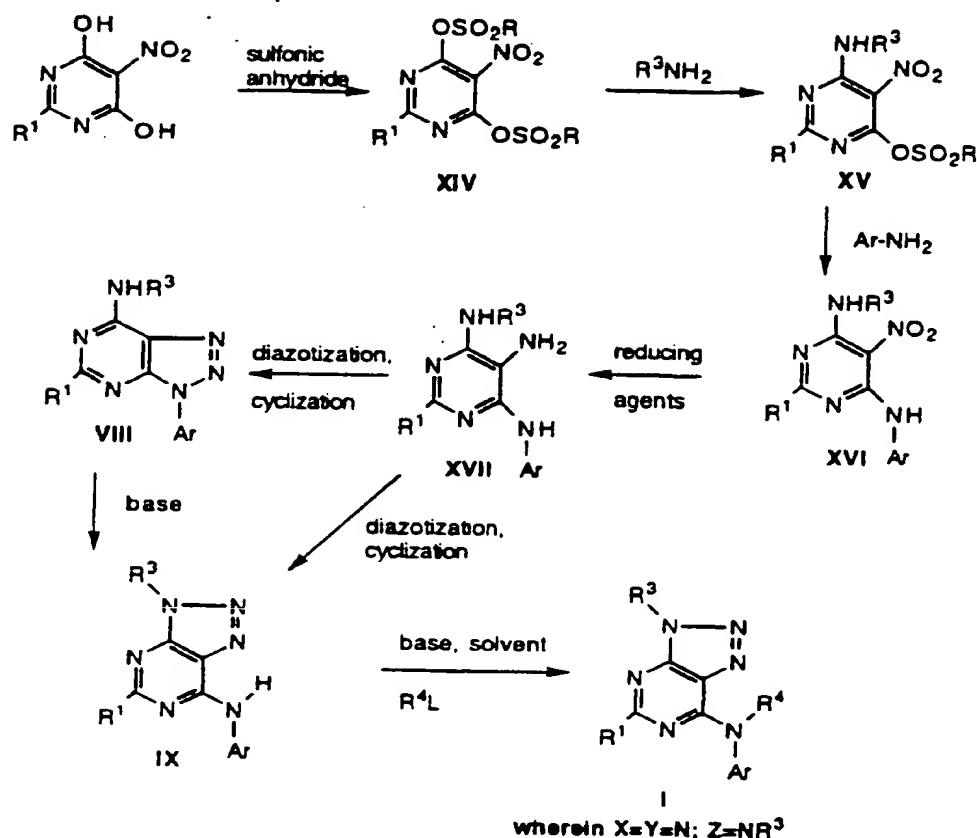


The nitro group in (XII) can be reduced to give compounds of Formula (VI) under conditions similar to those described for the transformation of (IV) to (V) in Scheme 1. Alternatively, as shown in Scheme 3, addition of Ar-NH₂ to compounds of Formula (IV) can

generate in-situ the pyrimidones (XIII). For example, treatment of dichloropyrimidines of Formula (IV) with one equivalent of Ar-NH₂ in the presence of solvents such as (but not limited to) dialkylsulfoxides, dialkylformamides, and alkyl alcohols readily generate pyrimidones (XIII). Compounds of Formula (XIII) can be converted into (IV) by the action of phosphorous oxychloride with the optional assistance of a catalyst such as dialkylanilines with or without an inert solvent. Compounds of Formula (VI) are elaborated to structures of Formula (I) as previously shown in Scheme 1.

Scheme 4 outlines another route to fused triazolopyrimidine type of compounds of this invention.

Scheme 4



4,6-dihydroxy-5-nitropyrimidines can be treated with
 aryl sulfonic anhydrides, aryl sulfonyl chlorides,
 5 alkyl sulfonic anhydrides or alkyl sulfonyl chlorides
 in the presence or absence of bases such as alkali
 metal hydrides, alkaline earth metal hydrides, alkali
 metal dialkyl amides in inert solvents such as
 dialkylformamides, dialkylacetamides at temperatures
 10 ranging from 0 ° to 200 °C to give intermediates of
 Formula (XIV). Compounds of Formula (XIV) are treated
 with primary amines to give aminonitropyrimidines
 (XV). Treatment of (XV) with Ar-NH₂ can provide
 compounds of Formula (XVI). Compounds of the formula
 15 (XVI) can be reduced to amino derivatives (XVII) using

the reagents described for the conversion of (IV) to (V) in Scheme 1.. Intermediate (XVII) can be converted to a mixture of (VIII) and (IX) by diazotization and cyclization. Compounds of the

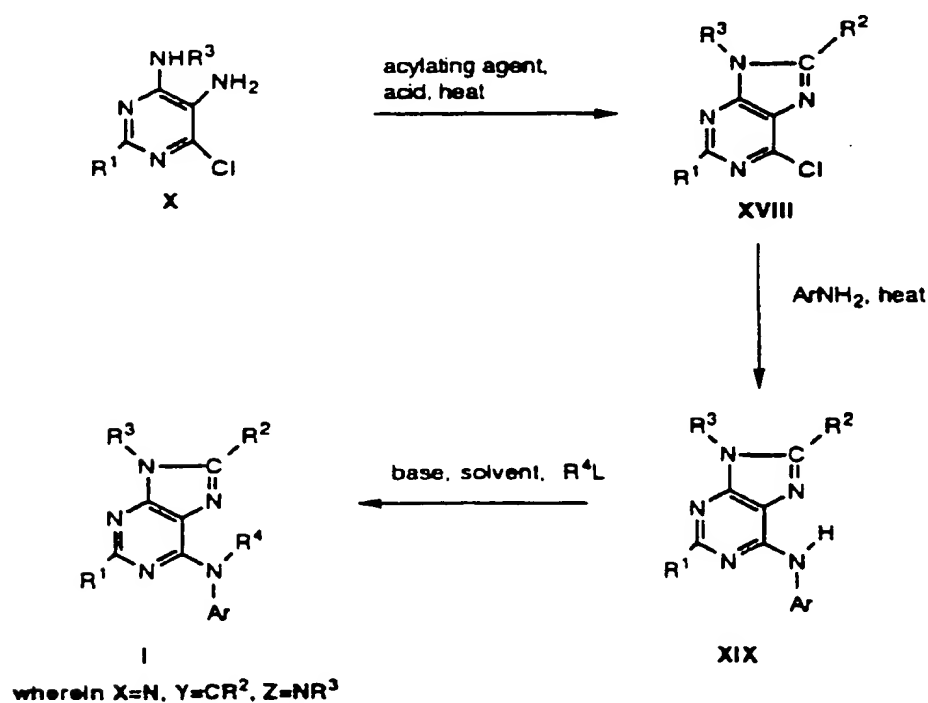
5 Formula (VIII) can be converted to (IX) by treatment with base such as but not limited to, alkali metal hydrides, alkaline earth metal hydrides, alkali metal dialkyl amides in an inert solvent. Compounds of

10 Formula (IX) are elaborated to give (I) as delineated in Scheme 1.

Fused imidazolopyrimidines of the Formula (I) wherein $X=N$, $Y=CR^2$, and $Z=NR^3$, can be prepared from compound (X) as shown in Scheme 5.

15

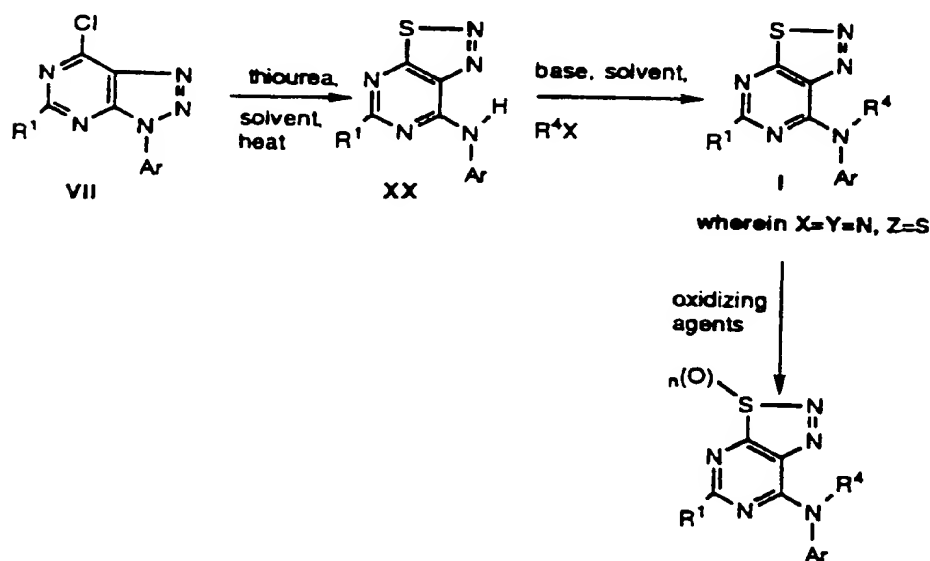
Scheme 5



Treatment of (X) with an acylating agent such as, but not limited to, alkyl anhydrides, haloalkyl anhydrides, alkylamides, haloalkyl amides, trialkylorthoesters $R^2(OR)_3$ (where R is C_1 - C_4 alkyl),
 5 guanidines, cyanogen bromide, R^2COOH , urea or thiourea in the presence or absence of an acid (such as HOAc, HCl, H_2SO_4) in the presence or absence of an organic cosolvent such as alkyl alcohols, cyclic ethers, or aromatic solvents at temperatures ranging from 0° to
 10 $200^\circ C$. Treatment of (XVIII) with $Ar-NH_2$ can provide compounds of Formula (XIX). Finally, alkylation of compound (XIX) can provide imidazolopyrimidine (I, wherein $X=N$, $Y=CR^2$, $Z=NR^3$).

The 1,2,3-thiadiazolo[5,4-d]pyrimidines of the
 15 formula (I) (wherein $X=Y=N$ and $Z=S$), can be prepared as shown in Scheme 6.

Scheme 6



20

Compounds of the formula (VII) with thiourea can react upon heating in presence of solvents such as but not limited to, cyclic ethers such as tetrahydrofuran,

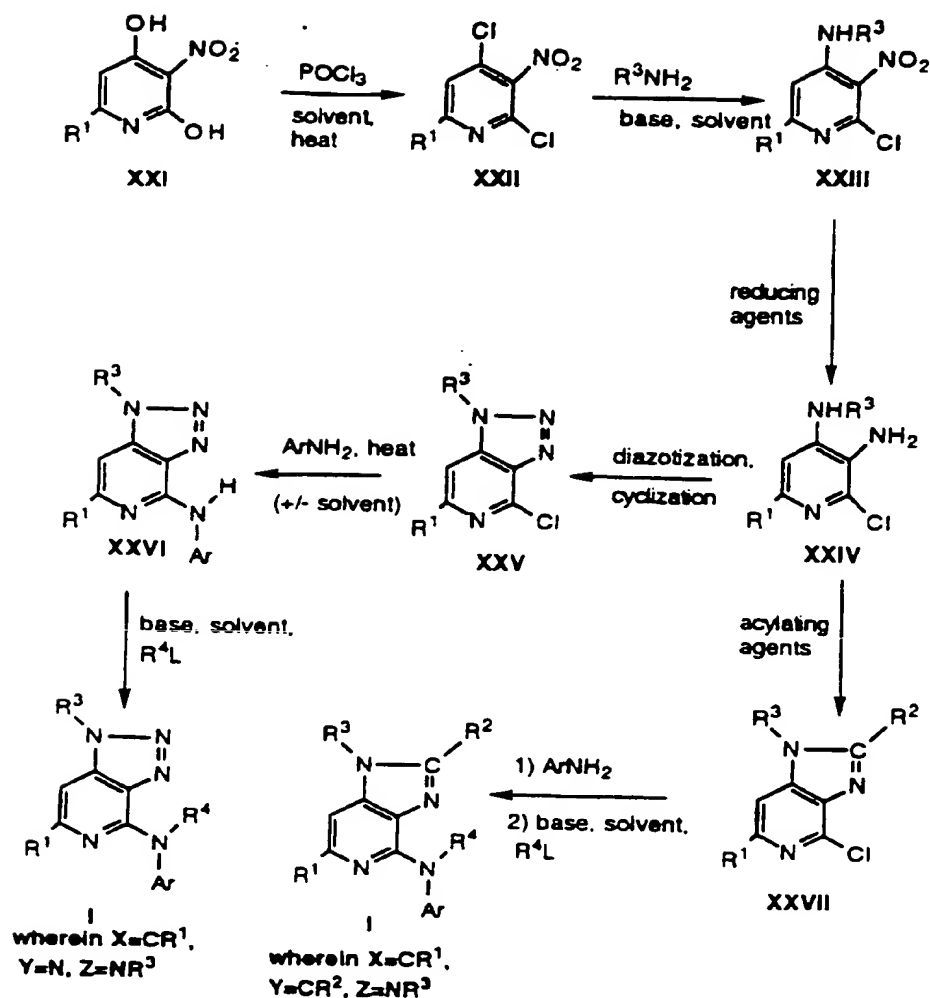
dialkylformamides such as dimethylformamide, dialkyl acetamides, ethylene glycol, 2-ethoxyethanol, halocarbons such as methylene chloride, alkanenitriles such as acetonitrile, or alkyl alcohols such as

5 methanol, ethanol to give compound (XX) which is alkylated to afford thiadiazolpyrimidine (I) (wherein $X=Y=N$ and $Z=S$). Compounds of Formula (I) can be converted to sulfoxides as well sulfones under a variety of oxidizing agents such as but not limited to

10 , $NaIO_4$, $KMnO_4$ or m-chloroperbenzoic acid.

The method of synthesis of the triazolopyridines of this invention is shown in Scheme 7.

Scheme 7



- The hydroxy groups in (XXI) can be converted into
chloro groups by the action of phosphorous oxychloride
with the optional assistance of a catalyst such as
dialkylaniline (see: Brown, D.J. et.al. J. Chem.
Soc., 1954, 3832) to afford compounds of Formula
(XXII). Addition of primary amines to compound
(XXII) can provide alkylaminonitropyridines (XXIII).
The nitro group in (XXIII) can be reduced using the
conditions employed for the transformation of (IV) to

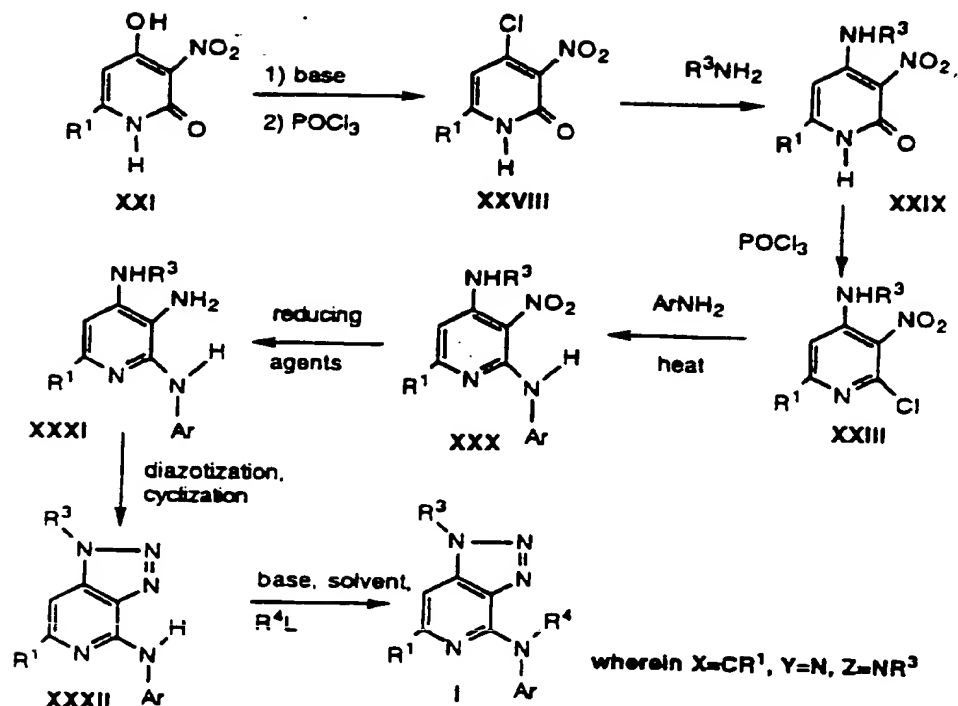
(V) to give (XXIV). Diazotization and cyclization of (XXIV) can provide chlorotriazolopyridine derivatives (XXV) as was described for the conversion of (VI) to (VII) in Scheme 1. The chloro group can then be
5 displaced by addition of Ar-NH₂ to afford compounds (XXVI) and then treated with R⁴L to give (I).

Imidazolopyridines of the present invention can be prepared from compound (XXIV) as shown in Scheme 7
10 by following the conditions outlined for the conversion of (X) to (XVIII) in Scheme 5. Treatment of compound (XXVII) with Ar-NH₂ using the conditions outlined in Scheme 1 can provide compounds of Formula (I, where R⁴=H). Alkylation with R⁴L can afford
15 imidazolopyridines of formula I (where R⁴ is not equal to H).

Alternatively, the triazolopyridines can be synthesized as shown in Scheme 8.

20

Scheme 8



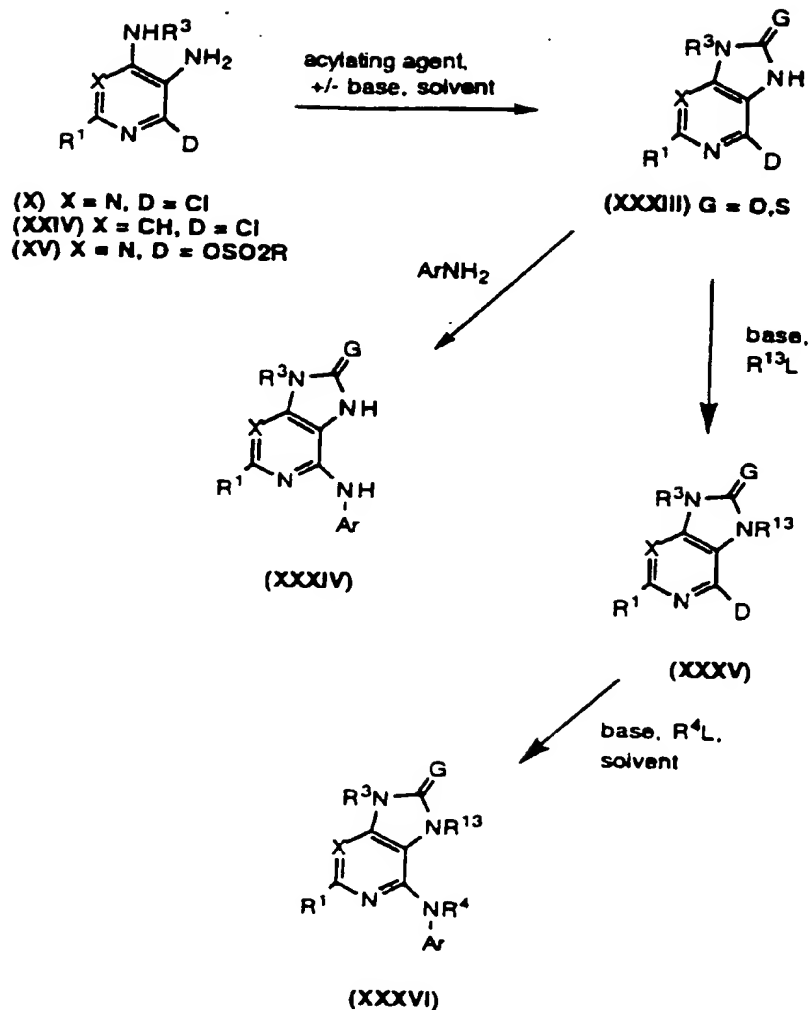
- 5 Treatment of compounds of Formula (XXI) with an aliphatic or aromatic amine in the appropriate organic solvent but not limited to, alkyl alcohols such as methanol, ethanol, propanol, butanol, alkyl alkanooates such as ethyl acetate, alkanenitriles such as acetonitrile, dialkyl formamides such as DMF gives
- 10 the corresponding ammonium salt, which upon treatment with $POCl_3$ at temperatures from 25 to 120 °C, give compounds of Formula (XXVIII). Treatment of compounds of Formula (XXVIII) with appropriate primary amines in an organic solvent such as but not limited to, alkyl
- 15 alcohols such as methanol, ethanol, propanol, butanol, alkyl alkanooates such as ethyl acetate, alkanenitriles such as acetonitrile, dialkyl formamides such as DMF, dialkylsulfoxides at temperatures from 25 to 120 °C to give (XXIX). This was converted to (XXIII) by

treatment with POCl_3 at temperatures from 25 to 120 °C. Compounds of Formula (XXIII) could be coupled with Ar-NH_2 with or without the presence of solvent at temperatures from 25 to 200 °C to give product (XXX).

- 5 These could be converted to intermediates (XXXI) by reduction of the nitro group under a variety of reducing conditions, such as those used for the conversion of (IV) to (V) in Scheme 1. The final cyclization was carried out as described for the
- 10 conversion of (VI) to (VII) in Scheme 1.

Compounds of general formula (II) may be prepared according to the procedures outlined in Scheme 9.

Scheme 9



Intermediates of formula (X), (XV) or (XXIV) may be converted to compounds of formula (XXXIII) by
 5 treatment with an acylating agent in the presence or absence of a base in an inert solvent at reaction temperatures ranging from $-78^{\circ}C$ to $200^{\circ}C$. Acylating agents include, but are not limited to, phosgene, thiophosgene, diphosgene, triphosgene, carbonyl
 10 diimidazole, thiocarbonyl diimidazole,

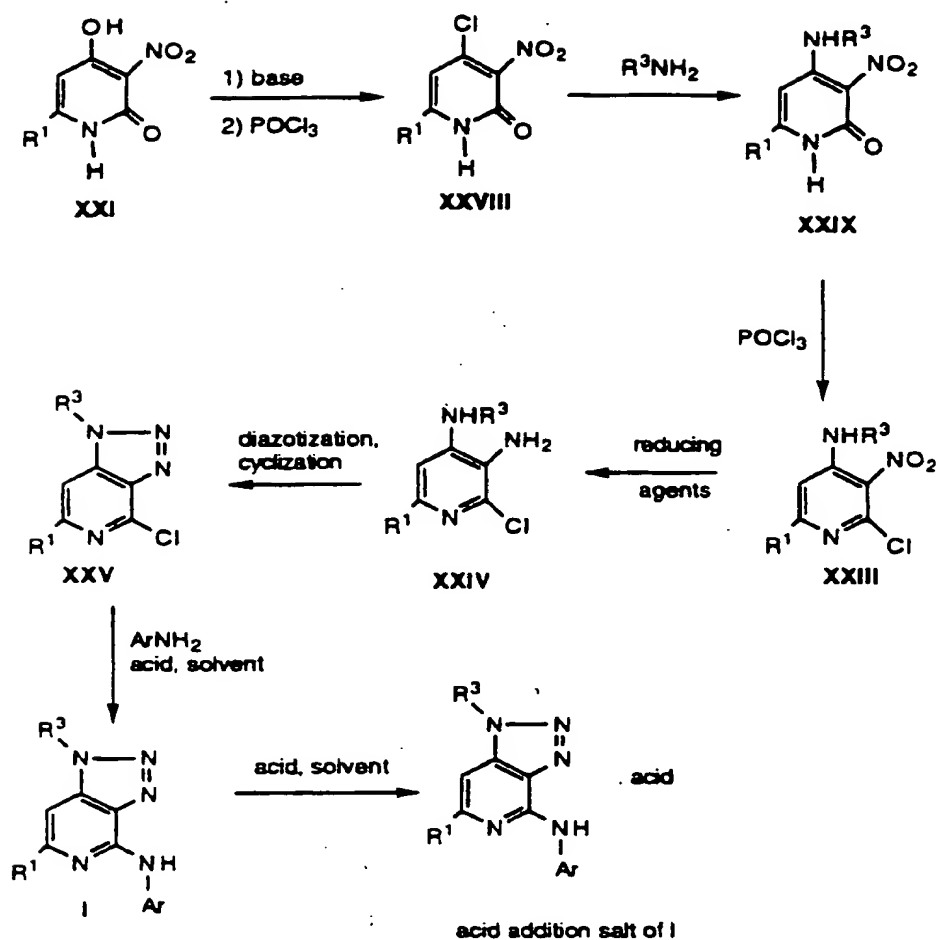
dialkylcarbonates (such as diethyl carbonate) or $R^aR^bN(C=G)OR^c$ (where $G = O, S$; R^a , R^b , and R^c are independently C1-C8 alkyl). Bases include, but are not limited to, alkali metal alkoxides, alkali metal hydrides, trialkyl amines, pyridine, 4-dimethylaminopyridine, alkali metal dialkyl amides or alkali metal bis(trimethylsilyl)amides. Inert solvents include, but are not limited to, halocarbons, alkanenitriles, dialkylformamides, dialkylacetamides, dialkyl ethers, cyclic ethers such as tetrahydrofuran or dioxane, or alkyl alcohols. Intermediates of (XXXIII) may be converted to compounds of formula (XXXIV) (Formula (II) where $R^4 = H$) by reaction with $ArNH_2$, using the conditions described for the conversion of compound (V) to (VI) in Scheme 1.

Compounds of Formula (XXXV) may be prepared from compounds of structure (XXXIII) by reaction with $R^{13}L$ (where L is a leaving group such as halide, alkanesulfonate or arylsulfonate) in the presence or absence of a base in an inert solvent. Bases and inert solvents may be the same as those listed above for the preparation of (XXXIII). Intermediates of Formula (XXXV) can be reacted with $ArNH_2$ to give compounds of formula (XXXVI) (Formula (II), where $R^4 = H$) using the conditions described for the conversion of compound (V) to (VI) in Scheme 1. Compounds of Formula (XXXVI) may be converted to compounds of (XXXVII) (Formula (II), where R^4 does not equal H) by treatment with R^4L (where L is a leaving group such as halide, alkanesulfonate or arylsulfonate) in the presence or absence of a base in an inert solvent. Bases and inert solvents may be the same as those listed above for the preparation of (XXXIII).

As illustrated in Scheme 10, treatment of compounds of Formula (XXI) with an aliphatic or

aromatic amine in an appropriate organic solvent (such as but not limited to, alkyl alcohols such as methanol, ethanol, propanol, butanol, alkyl alkanoates such as ethyl acetate, alkanenitriles such as acetonitrile, dialkyl formamides such as DMF) gives the corresponding ammonium salt, which upon treatment with POCl_3 at temperatures from 25 to 120 °C, give compounds of Formula (XXVIII). Treatment of compounds of Formula (XXVIII) with appropriate primary amines R^3NH_2 in an organic solvent (such as but not limited to, alkyl alcohols such as methanol, ethanol, propanol, butanol, alkyl alkanoates such as ethyl acetate, alkanenitriles such as acetonitrile, dialkyl formamides such as DMF, dialkylsulfoxides) at temperatures from 25 to 120 °C provides compounds of Formula (XXIX). These can be converted to (XXIII) by treatment with POCl_3 at temperatures from 25 to 120 °C. Compounds of Formula (XXIII) can be converted to intermediates (XXIV) by reduction of the nitro group under a variety of reducing conditions, such as those used for the conversion of (IV) to (V) in Scheme 1. Diazotization and cyclization of (XXIV) can provide chlorotriazolopyridine (XXV) as was described for the conversion of (VI) to (VII) in Scheme I. The chloro group can then be displaced by addition of Ar-NH_2 in the presence of an acid such as but not limited to HCl , H_2SO_4 , AcOH , methanesulfonic acid, p-toluenesulfonic acid in inert solvents such as toluene, xylenes at temperatures ranging from 0 ° to 200 °C to afford product I. Salts of I are prepared by combining the free base with appropriate acid in a suitable organic solvent.

Scheme 10

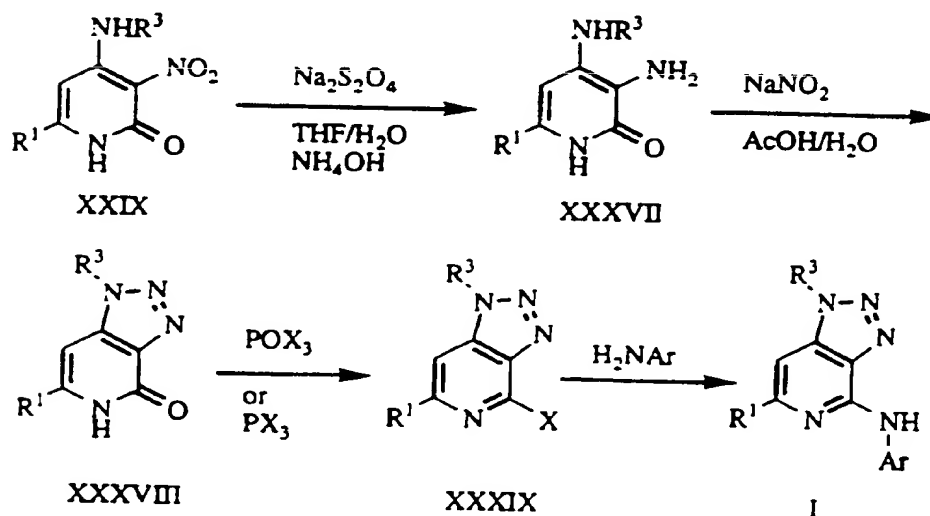


As shown in Scheme 11, reaction of a 4-amino-3-nitro-pyridone of formula (XXIX) with a reducing agent, such as $Na_2S_2O_4$ affords the corresponding 4-amino-3-amino-pyridone of formula (XXXVII). This transformation can be effected under a variety of reducing conditions, such as catalytic hydrogenation, reducing metal reaction (Fe, Sn, Zn), hydride reaction ($NaBH_4$, $LiAlH_4$) etc., which are known to those skilled in the art. The 4-amino-3-amino-pyridone can be converted to the

triazolopyridone of formula (XXXVIII) by treatment with
 an alkali metal nitrite, such as NaNO_2 , under acidic
 conditions. The resulting triazolopyridone can be
 converted to the corresponding halo-triazolopyridine of
 formula (XXXIX) ($\text{X} = \text{Cl}, \text{Br}$), by treatment with a
 5 halogenating agent such as POCl_3 , PBr_3 , POBr_3 .
 Alternatively X can be an appropriate leaving group
 resulting from treatment of the triazolopyridone with
 triflic, tosic or mesyl anhydride in the presence of a
 10 base. The triazolopyridine can be coupled with
 arylamines ArNH_2 under acidic, basic or thermal
 catalysis to compounds of Formula I.

15

Scheme 11



Example 1

N-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-3-propyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: 4,6-Dihydroxy-2-methylpyrimidine (60 g) was added in portions to fuming nitric acid (120 mL) at 0 °C while cooling the reaction flask. After completion of addition, the reaction was stirred an additional 1 h at 0 °C followed by another 1 h at room temperature. The reaction mixture was then poured over ice (200 g) and the ice was allowed to melt. A light pink solid was isolated by filtration and washed with cold water (100 mL). The solid was dried in a vacuum oven overnight to yield 4,6-dihydroxy-2-methyl-5-nitropyrimidine (72.5 g).

Part B: The product of Part A was added portionwise to phosphorous oxychloride (400 mL) under a nitrogen atmosphere followed by dropwise addition of N,N-diethylaniline (80 mL). The reaction mixture was refluxed for 2 1/2 h with stirring, cooled to room temperature, poured over ice (2.0 Kg) and stirred for 1 hr. The aqueous layer was extracted with diethyl ether (4 x 500 mL) and the extracts combined. The combined extracts were washed with brine (500 mL), dried over anhydrous magnesium sulfate, filtered and stripped down to afford 4,6-dichloro-2-methyl-5-nitropyrimidine as a yellow solid (68.8 g) which has an unpleasant odor.

Part C: The product of Part B (42 g) was added to acetic acid (77 mL) and methanol (350 mL). To this mixture was added iron powder (42 g) in portions, stirred for 2 h at 60-65 °C, cooled to room

temperature, and filtered. The filtrate was stripped to a brown solid, which was extracted with ethyl acetate (2 x 500 mL), washed with 1N NaOH (250 mL), and brine (500 mL). The organic layer was dried over anhydrous magnesium sulfate, filtered and stripped down to yield 5-amino-4,6-dichloro-2-methylpyrimidine as a pale yellow solid (25.4 g).

Part D: The product of Part C (14.2 g) and 2-bromo-4-isopropylaniline (17.1 g) were dissolved in 2-ethoxyethanol (60 mL) and refluxed at 135 °C for 30 h. The reaction mixture was cooled, removed the solvent, extracted the residue with dichloromethane, washed with water, dried over anhydrous magnesium sulfate. Filtered the extract, removed the solvent and residue was purified by flash column chromatography on a silica gel using methanol + CH₂Cl₂ (1:100) to yield 5-amino-4-(2-bromo-4-isopropylphenyl)- amino-6-chloro-2-methylpyrimidine as a cream colored solid (16.05 g).

Part E: The product of Part D (12.5 g) was dissolved in dichloromethane (125 mL) and 50 % aqueous acetic acid (125 mL). To this stirred mixture was added sodium nitrite (2.55 g) in water (10 mL) dropwise at room temperature. After completion of addition, the reaction was stirred for an additional 15 mins. The organic layer was separated, washed with water, dried with anhydrous magnesium sulfate, and stripped down to a residue. The residue was purified by flash column chromatography (CH₂Cl₂) to afford light brown oil. The oil was crystallized from 1:1 hexane + pentane (15 mL) to yield 3-[2-bromo-4-(1-methylethyl)phenyl]-7-chloro-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidine as an off-white solid (12.15 g).

Part F: The product of Part E (0.65 g) was dissolved in dichloromethane (20 mL) and then added 1.0 g of 1-propylamine at room temperature. The reaction mixture was stirred at room temperature for 1 h, washed with water, dried with anhydrous magnesium sulfate, and stripped down to a white solid. The crude solid was recrystallized from 2-propanol (2 mL) to furnish 3-(2-bromo-4-(1-methylethyl)phenyl)-5-methyl-N-propyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white needles (0.58 g; mp 156-157 °C). Elemental analysis for C₁₇H₂₁BrN₆: Theory C: 52.45, H: 5.45, N: 21.59. Found: C: 52.47, H: 5.33, N: 21.46.

Part G: Rearrangement of Product F: The product of Part F (0.40 g) was dissolved in dry DMF (10 mL) and added NaH (0.103 g, 60% in oil) at room temperature under a nitrogen atmosphere. The mixture was stirred at room temperature for 14 h and partitioned between ethyl acetate (25 mL) and water (25 mL). The organic layer was washed with brine, dried, and stripped in vacuum to a solid. The solid was recrystallized from 2-propanol (0.5 mL) to afford the title compound as a white crystalline solid (0.35 g; mp 80-81 °C). Elemental analysis for C₁₇H₂₁BrN₆: Theory C: 52.45, H: 5.45, N: 21.59. Found: C: 52.19, H: 5.37, N: 21.48.

Example 2

N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-5-methyl-3-propyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

The title compound from Example 1 (0.30 g) was dissolved in dry DMF (10 mL) and added NaH (62 mg; 60% in oil) at room temperature under a nitrogen atmosphere. The reaction mixture was stirred for 5 mins., and then added EtI (0.2 mL) and continued for

an additional 24 h. The reaction mixture was partitioned between ethyl acetate (25 mL) and water (25 mL), washed the organic layer with brine, dried, and stripped in vacuum to yield a pale yellow oil.

- 5 The sample was purified by flash column chromatography (1:100 MeOH + CH₂Cl₂) to afford the title compound as a colorless oil (0.16 g). Elemental analysis for C₁₉H₂₅BrN₆: Theory C: 54.68, H: 6.05 Found: C: 54.66, H: 6.02.

10

Example 3

N-[2-bromo-4-(1-methylethyl)phenyl]-3-butyl-*N*-ethyl-5-methyl-3*H*-1,2,3-triazolo[4,5-
d]pyrimidin-7-amine

15

- Part A: The product of Part E from Example 1 was treated with 1-butylamine in the same manner as outlined in Part F to afford 3-[2-bromo-4-(1-methylethyl)phenyl]-*N*-butyl-5-methyl-3*H*-1,2,3-
20 triazolo[4,5-*d*]pyrimidin-7-amine as a white solid (mp 149-151 °C). Elemental analysis for C₁₈H₂₃BrN₆: Theory C: 53.60, H: 5.76, N: 20.84. Found: C: 53.46, H: 5.62, N: 20.80.

25

- Part B: The product of Part A from Example 3 (0.34 g) was dissolved in dry DMF (10 mL) and added NaH (67 mg; 60% in oil) at room temperature under a nitrogen atmosphere. The reaction mixture was stirred for 24 h, then added EtI (0.1 mL) and continued for
30 another 24 hrs. The title compound was isolated in the same way as described in Example 2 to afford colorless oil (0.21 g). Elemental analysis for C₂₀H₂₇BrN₆: Theory C: 55.69, H: 6.32, N: 19.48. Found: C: 55.61, H: 6.19, N: 19.23.

35

Example 4

***N*-[2-bromo-4-(1-methylethyl)phenyl]-3-(cyclopropylmethyl)-*N*-ethyl-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine**

5 **Part A:** The product of Part E from Example 1 was reacted with aminomethylcyclopropane in the same way as outlined in Part F to furnish 3-(2-bromo-4-(1-methylethyl)phenyl)-*N*-(cyclopropyl-methyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine as a white
10 needles (mp 166-167 °C). Elemental analysis for C₁₈H₂₁BrN₆: Theory C: 53.87, H: 5.27, N: 20.94. Found: C: 54.11, H: 5.32, N: 21.08.

Part B: Using the procedure for Part G in
15 Example 1, the product of Part A in Example 4 was rearranged to yield the title compound as a white crystalline solid (mp 100-101 °C). Elemental analysis for C₁₈H₂₁BrN₆: Theory C: 53.87, H: 5.27, N: 20.94. Found: C: 53.93, H: 5.28, N: 20.78.

20 **Part C:** Using the procedure for Example 2, the product of Part B from above was alkylated to furnish the title compound as a colorless oil. Elemental analysis for C₂₀H₂₅BrN₆: Theory C: 55.95, H: 5.88, N: 19.57. Found: C: 56.11, H: 6.04, N: 19.23.

Example 5

***N*-[2-bromo-4-(1-methyl)ethylphenyl]-5-methyl-3-[(1-methoxymethyl)-2-methoxyethyl]-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine**
30

Part A: Serinol (3.42 g) was added to a solution of trityl chloride (8.36 g) and triethylamine in 75 mL of dry DMF. After stirring at room
35 temperature overnight, the reaction was poured into water and extracted twice with toluene. The combined organic layers were dried over potassium carbonate and

concentrated to dryness. Recrystallization from boiling 1:1 benzene/hexane (two crops) afforded N-triphenylmethylserinol (7.59 g).

5 **Part B:** Methyl iodide (2.60 mL) was added to a suspension of N-triphenylmethylserinol (6.34 g) and powdered sodium hydroxide (7.60 g) in 95 mL of dry DMSO. After stirring overnight, more methyl iodide was added (0.35 mL). After stirring for an additional
10 24 h, the reaction was added to water and extracted with toluene, toluene/ether, and then ether. The combined organic layers were dried over potassium carbonate and concentrated to afford 1,3-dimethoxy-2-triphenylmethylaminopropane (7.00 g) as a thick
15 viscous oil.

Part C: To a solution of the product of Part B (1.45 g) in methanol (32 mL) was added 1 M HCl in ether (8.4 mL). After stirring overnight, the
20 reaction was added to hexane and extracted with 1:1 methanol/water. The methanol/water layer was washed twice with hexane and concentrated to dryness to afford 1,3-dimethoxy-2-aminopropane hydrochloride (600 mg) as a waxy solid.

25
Part D: The product of Part C (576 mg), 3-[2-bromo-4-(1-methyl)ethylphenyl]-7-chloro-5-methyl-3H-1,2,3-triazolo[4,5-d] pyrimidine (0.733 g, from Example 1, Part E) and triethylamine (0.56 mL) were
30 stirred overnight at room temperature. The reaction mixture was added to aqueous sodium dihydrogen phosphate and extracted three times with dichloromethane. The combined organic layers were dried over magnesium sulfate and concentrated.
35 Recrystallization from ether/hexane and then boiling methanol afforded N-(1-methoxymethyl-2-methoxyethyl)-3-[2-bromo-4-(1-methyl)ethylphenyl]-5-methyl-3H-1,2,3-

triazolo[4,5-d]pyrimidin-7-amine (855 mg) as crystals melting 156.0-158.5°. Calculated for C₁₉H₂₅N₆O₂Br: C, 50.79%; H, 5.62%; N, 18.70%. Found: C, 50.48%; H, 5.65%; N, 18.41%.

5

Part E: The product of Part D (449 mg), dry t-butanol (8 mL) and 1 M potassium t-butoxide (2 mL) were heated at reflux for 2 h. The reaction mixture was added to saturated aqueous ammonium chloride and extracted with dichloromethane. The combined organic layers were dried over magnesium sulfate and concentrated to dryness. The residue crystallized after partial evaporation of a dichloromethane/ether/hexane solution, affording the title compound (403 mg) as an amorphous white solid melting 53.5-60.0°. Calculated for C₁₉H₂₅N₆O₂Br: C, 50.79%; H, 5.62%; N, 18.70%. Found: C, 50.92%; H, 5.62%; N, 18.77%.

20

Example 6

N-[2-bromo-4-(1-methylethyl)phenyl]-3-(2-methoxyethyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

25

Part A: The product of Part E from Example 1 was reacted with 2-methoxyethylamine in the same way as outlined in Part F to furnish 3-[2-bromo-4-(1-methylethyl)phenyl]-N-(2-methoxyethyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white solid (mp 134-136 °C). Elemental analysis for C₁₇H₂₁BrN₆O: Theory C: 50.38, H: 5.22, N: 20.74. Found: C: 50.37, H: 5.32, N: 20.52.

30

Part B: Using the procedure for Part G in Example 1, the product of Part A in Example 6 was rearranged to yield the title compound as a white crystalline solid (mp 94-95 °C). Elemental analysis

35

for C₁₇H₂₁BrN₆O: Theory C: 50.38, H: 5.22, N: 20.74.
Found: C: 50.40, H: 5.31, N: 20.65.

Example 7

5 *N*-[2-bromo-4-(1-methylethyl)phenyl]-*N*-ethyl-3-(2-methoxyethyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*] pyrimidin-7-amine

Using the procedure for Example 2, the product
10 of Part B in Example 6 was alkylated to furnish the title compound as a colorless oil. Elemental analysis for C₁₉H₂₅BrN₆O: Theory C: 52.66, H: 5.81, N: 19.39.
Found: C: 52.85, H: 5.96, N: 19.02.

Example 8

15 *N*-[2-bromo-4-(1-methylethyl)phenyl]-*N*-ethyl-3-(3-methoxypropyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*] pyrimidin-7-amine

20 **Part A:** The product of Part E from Example 1 was treated with 3-methoxyethylamine in the same manner as outlined in Part F to afford 3-[2-bromo-4-(1-methylethyl)phenyl]-*N*-ethyl-*N*-(3-methoxypropyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine as a
25 white solid (mp 109-110 °C). Elemental analysis for C₁₈H₂₃BrN₆O: Theory C: 51.56, H: 5.54, N: 20.04.
Found: C: 51.57, H: 5.40, N: 20.23.

30 **Part B:** The product of Part A from Example 8 was rearranged and alkylated in the same way as outlined in Part B of Example 3 to furnish the title compound as a colorless oil. Elemental analysis for C₂₀H₂₇BrN₆O: Theory C: 53.69, H: 6.08, N: 18.79.
Found: C: 53.63, H: 5.98, N: 18.59.

Example 9

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d] pyrimidin-7-amine

- 5 **Part A:** The product of Part E (0.72 g) from Example 1 was dissolved in a mixture of ethanol (10 mL) and triethylamine (0.21 g) and added 2-amino-1-methoxybutane (0.23 g). The reaction mixture was refluxed for 8 h, removed the solvent, partitioned
10 between ethyl acetate (25 mL) and water (25 mL), washed the organic layer with brine, dried and stripped down to a residue. The residue was purified by flash column chromatography (1:100 MeOH + CH₂Cl₂)
15 to afford (+/-)-3-[2-bromo-4-(1-methylethyl)phenyl]-N-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white solid (mp 132-134 °C). Elemental analysis for C₁₉H₂₅BrN₆O: Theory C: 52.66, H: 5.81, N: 19.39. Found: C: 52.52, H: 5.72, N: 19.46.

- 20 **Part B:** The product of Part A from Example 9 was rearranged in a manner similar to Part G of Example 1 to furnish the title compound as a white crystalline solid (mp 115-116 °C). Elemental analysis
25 for C₁₉H₂₅BrN₆O: Theory C: 52.66, H: 5.81, N: 19.39. Found: C: 52.61, H: 5.70, N: 19.41.

Example 10

- 30 (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d] pyrimidin-7-amine

- 35 Using the procedure for Example 2, the product of Part B in Example 9 was alkylated to afford the title compound as a colorless oil. Elemental analysis for C₂₁H₂₉BrN₆O: Theory C: 54.66, H: 6.35, N: 18.21. Found: C: 54.76, H: 6.86, N: 17.85.

Example 11

(S)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-(1-methoxymethyl)-2-phenylethyl]-5-methyl-3H-1,2,3-triazolo[4,5-d] pyrimidin-7-amine

Part A: The product of Part E from Example 1 was treated with S-(+)-2-amino-1-methoxy-3-phenylpropane hydrochloride in the same manner as outlined in Part A of Example 9 to afford (S)-3-[2-bromo-4-(1-methylethyl)phenyl]-N-[1-(1-methoxymethyl)-2-phenylethyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white solid (mp 67-69 °C). Elemental analysis for C₂₄H₂₇BrN₆O: Theory C: 58.18, H: 5.49, N: 16.96. Found: C: 57.79, H: 5.39, N: 16.77.

Part B: The product of Part A from Example 11 was rearranged in the same way as outlined in Part G of Example 1 to furnish the title compound as a colorless oil. Elemental analysis for C₂₄H₂₇BrN₆O: Theory C: 58.18, H: 5.49, N: 16.96. Found: C: 57.94, H: 5.49, N: 16.43.

Example 12

(S)-methyl 7-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-a-[2-(methylthio)ethyl]-3H-1,2,3-triazolo[4,5-d] pyrimidine-3-acetate

Part A: The product of Part E from Example 1 was treated with L-methionine methyl ester hydrochloride in the same manner as outlined in Part A of Example 9 to afford (S)-methyl 3-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-a-[2-(methylthio)ethyl]-3H-1,2,3-triazolo[4,5-d] pyrimidine-7-acetate as a white solid (mp 135-137 °C). Elemental analysis for

C₂₀H₂₅BrN₆O₂S: Theory C: 48.68, H: 5.12, N: 17.03.
Found: C: 48.73, H: 5.21, N: 16.90.

5 **Part B:** The product of Part A from Example 12
was rearranged in the same way as described in Part G
of Example 1 to furnish the title compound as a
colorless oil. Elemental analysis for C₂₀H₂₅BrN₆O₂S:
Theory C: 48.68, H: 5.12, N: 17.03. Found: C: 48.55,
H: 5.19, N: 16.82.

10

Example 13

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-
ethylpentyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]
pyrimidin-7-amine

15

Part A: The product of Part E from Example 1
was reacted with 3-aminoheptane in the same way as
outlined in Part F to yield 3-[2-bromo-4-(1-
methylethyl)phenyl]-N-[1-ethylpentyl]-5-methyl-3H-
20 1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white
crystalline solid (mp 137-138 °C). Elemental analysis
for C₂₁H₂₉BrN₆: Theory C: 56.63, H: 6.56, N: 18.87.
Found: C: 56.53, H: 6.54, N: 18.79.

25 **Part B:** Using the procedure for Part G in
Example 1, the product of Part A in Example 13 was
rearranged to yield the title compound as a colorless
oil. Elemental analysis for C₂₁H₂₉BrN₆: Theory C:
56.63, H: 6.56, N: 18.87. Found: C: 56.78, H: 6.58,
30 N: 18.79.

Example 14

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-N-
ethyl-3-[1-ethylpentyl]-5-methyl-3H-1,2,3-
35 triazolo[4,5-d]pyrimidin-7-amine

Using the procedure for Example 2, the product of Part B in Example 13 was alkylated to furnish the title compound as a colorless oil. Mass spec. (ESI): 473.4

5

Example 15

N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-propylbutyl]-5-methyl-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

10

Part A: The product of Part E from Example 1 was reacted with 4-aminoheptane in the same manner as outlined in Part A of Example 9 to yield 3-[2-bromo-4-(1-methylethyl)phenyl]-*N*-(1-propylbutyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white crystalline solid (mp 162-163 °C). Elemental analysis for C₂₁H₂₉BrN₆: Theory C: 56.63, H: 6.56, N: 18.87. Found: C: 56.64, H: 6.56, N: 18.81.

20

Part B: Using the procedure for Part G in Example 1, the product of Part A in Example 15 was rearranged to yield the title compound as a white crystalline solid (mp 69-70 °C). Elemental analysis for C₂₁H₂₉BrN₆: Theory C: 56.63, H: 6.56, N: 18.87. Found: C: 56.69, H: 6.48, N: 18.97.

25

Example 16

N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-butylpentyl]-5-methyl-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

30

Part A: The product of Part E from Example 1 was reacted with 5-aminononane in a manner similar to Part A of Example 9 to yield 3-[2-bromo-4-(1-methylethyl)phenyl]-*N*-(1-butylpentyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white crystalline solid (mp 132-133 °C). Elemental analysis

35

for C₂₃H₃₃BrN₆: Theory C: 58.35, H: 7.04, N: 17.75.
Found: C: 58.19, H: 7.00, N: 17.97.

5 **Part B:** Using the procedure for Part G in
Example 1, the product of Part A in Example 16 was
rearranged to yield the title compound as a colorless
oil. Elemental analysis for C₂₃H₃₃BrN₆: Theory C:
58.35, H: 7.04, N: 17.75. Found: C: 58.58, H: 7.12,
N: 17.47.

10

Example 17

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-
ethylbutyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]
pyrimidin-7-amine

15

Part A: The product of Part E from Example 1
was reacted with 3-aminohexane in a manner similar to
Part A of Example 9 to yield 3-[2-bromo-4-(1-
methylethyl)phenyl]-N-[1-ethylbutyl]-5-methyl-3H-
20 1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white
crystalline solid (mp 154-155 °C). Elemental analysis
for C₂₀H₂₇BrN₆: Theory C: 55.69, H: 6.32, N: 19.48.
Found: C: 55.57, H: 6.31, N: 19.41.

25 **Part B:** Using the procedure for Part G in
Example 1, the product of Part A in Example 17 was
rearranged to yield the title compound as a white
crystalline solid (87-88 °C). Elemental analysis for
C₂₀H₂₇BrN₆: Theory C: 55.69, H: 6.32, N: 19.48.
30 Found: C: 55.70, H: 6.36, N: 19.40.

Example 18

(+/-)-7-[2-bromo-4-(1-methylethyl)phenyl]-5-
methyl- α -propyl-3H-1,2,3-triazolo[4,5-
35 d]pyrimidine-3-ethanol

Part A: The product of Part E from Example 1 was treated with DL-2-amino-1-pentanol in a manner similar to Part A of Example 9 to furnish 3-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl- α -propyl-3H-1,2,3-triazolo[4,5-d]pyrimidine-7-ethanol as a white crystalline solid (mp 154-155 °C). Elemental analysis for C₁₉H₂₅BrN₆O: Theory C: 52.66, H: 5.83, N: 19.39. Found: C: 52.54, H: 5.64, N: 19.12.

Part B: Using the procedure for Part G in Example 1, the product of Part A in Example 18 was rearranged to afford the title compound as a colorless oil. Elemental analysis for C₁₉H₂₅BrN₆O: Theory C: 52.66, H: 5.83, N: 19.39. Found: C: 52.46, H: 5.83, N: 19.18.

Example 19

N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-ethylpropyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: The product of Part E from Example 1 was reacted with 3-aminopentane in the same manner as outlined in Part A of Example 9 to yield 3-[2-bromo-4-(1-methylethyl)phenyl]-N-[1-ethylpropyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine as a white crystalline solid (mp 171-172 °C). Elemental analysis for C₁₉H₂₅BrN₆: Theory C: 54.68, H: 6.05, N: 20.14. Found: C: 54.54, H: 5.73, N: 20.18.

Part B: Using the procedure for Part G in Example 1, the product of Part A in Example 19 was rearranged to yield the title compound as a white crystalline solid (mp 117-118 °C). Elemental analysis for C₂₁H₂₉BrN₆: Theory C: 56.63, H: 6.56, N: 18.87. Found: C: 54.86, H: 5.93, N: 20.17.

Example 20

***N*-(2-bromo-4-(1-methylethyl)phenyl)-*N*-ethyl-3-[1-ethylpropyl]-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine**

5

Using the procedure for Example 2, the product of Part B in Example 19 was alkylated to afford the title compound as a colorless oil. Elemental analysis for C₂₁H₂₉BrN₆: Theory C: 56.63, H: 6.56, N: 18.87.

10 Found: C: 56.63, H: 6.33, N: 18.78.

Example 21

***N*-(2-bromo-4,6-dimethylphenyl)-5-methyl-3-[1-propylbutyl]-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine**

15

Part A: The product of Part D (9 g) from Example 1 was dissolved in ethanol (100 mL) and *N,N*-diisopropylethylamine (8 g). To this mixture 4-aminoheptane (7.65 g) was added and refluxed for 7 days. The ethanol was stripped off in vacuum, the residue was partitioned between ethyl acetate (250 mL) and water (150 mL). The ethyl acetate layer was washed with brine (100 mL), dried and stripped in vacuum to a pale yellow solid. Recrystallized from 2-propanol (20 mL) to yield 5-amino-4-chloro-6-(4-heptyl)amino-2-methylpyrimidine as a white crystalline solid (12.5 g; mp 162-163 °C). Elemental analysis for C₁₂H₂₁ClN₄: Theory C: 56.13, H: 8.24, N: 21.82.

30 Found: C: 55.94, H: 8.22, N: 21.78.

Part B: Using the procedure for Part E in Example 1, the product of Part A in Example 21 was cyclized to yield 7-chloro-5-methyl-3-[1-propylbutyl]-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidine as a pale yellow solid (mp 92-93 °C). Elemental analysis for

35

C₁₂H₁₈ClN₅: Theory C: 53.83, H: 6.79, N: 26.16.
Found: C: 53.81, H: 6.60, N: 25.98.

Part C : The product of Part B (0.27 g) from
5 above was combined with 4-bromo-2,6-dimethylaniline
(0.2 g) and heated at 150 °C for 4h. The reaction
mixture was partitioned between dichloromethane (20
mL) and water (20 mL), washed the organic layer with
water, dried and stripped in vacuum to a residue.
10 The residue was purified by flash column
chromatography (1:100 MeOH + CH₂Cl₂) to afford the
title compound as an off-white solid (0.26 g; mp 141-
142 °C). Elemental analysis for C₂₀H₂₇BrN₆: Theory C:
55.69, H: 6.32, N: 19.48. Found: C: 56.05, H: 6.26,
15 N: 19.71.

Example 22

5-methyl-N-[4-(1-methylethyl)-2-
(methylthio)phenyl]-3-[1-propylbutyl]-3H-1,2,3-
20 triazolo[4,5-d]pyrimidin-7-amine

The product of Part B from Example 21 was
treated with 4-isopropyl-2-methylthioaniline in a
manner similar to Part C in Example 21, to yield the
25 title compound as a pale yellow oil. Elemental
analysis for C₂₂H₃₂N₆S: Theory C: 64.04, H: 7.83, N:
20.37. Found: C: 64.12, H: 7.54, N: 20.41.

Example 23

30 N-[2-bromo-4-(trifluoromethyl)phenyl]-5-methyl-
3-[1-propylbutyl]-3H-1,2,3-triazolo[4,5-
d]pyrimidin-7-amine

The product of Part B from Example 21 was
35 combined with 2-bromo-4-trifluoromethylaniline in a
manner similar to Part C in Example 21, to yield the
title compound as a white crystalline solid (mp 84-85

°C). Elemental analysis for C₁₉H₂₂BrF₃N₆: Theory C: 48.42, H: 4.70, N: 17.83. Found: C: 48.58, H: 4.50, N: 17.78.

5

Example 24

N-[2-bromo-4,6-(dimethoxy)phenyl]-5-methyl-3-[1-propylbutyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

10

The product of Part B from Example 21 was combined with 2-bromo-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a white crystalline solid (mp 146-147 °C). Elemental analysis for C₂₀H₂₇BrN₆O₂: Theory C: 51.84, H: 5.87, N: 18.14. Found: C: 51.95, H: 5.68, N: 18.15.

15

Example 25

N-[2,6-dimethyl-4-(methylthio)phenyl]-5-methyl-3-[1-propylbutyl]-3H-1,2,3-triazolo[4,5-d] pyrimidin-7-amine

20

The product of Part B from Example 21 was combined with 2,6-dimethyl-4-methylthioaniline in a manner similar to Part C in Example 21, to yield the title compound as a cream colored solid (mp 139-140 °C). Elemental analysis for C₂₁H₃₀N₆S: Theory C: 63.28, H: 7.60, N: 21.09. Found: C: 62.98, H: 7.32, N: 21.38.

25

30

Example 26

N-(4-acetyl-2-bromophenyl)-3-[1-ethylpropyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

35

Part A: The product of Part D from Example 1 was treated with 3-aminopentane in a manner similar

to Part A of Example 21, to yield 5-amino-4-chloro-2-methyl-6-(3-pentyl)aminopyrimidine as a white crystalline solid (mp 155-156 °C). Elemental analysis for C₁₀H₁₇ClN₄: Theory C: 52.51, H: 7.49, N: 24.50.

5 Found: C: 52.43, H: 7.31, N: 24.59.

Part B: The product of Part A from above was cyclized in a manner similar to Part E of Example 1 to yield 7-chloro-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidine as a white crystalline solid (mp 96-97 °C). Elemental analysis for C₁₀H₁₄ClN₅: Theory C: 50.11, H: 5.90, N: 29.22. Found: C: 50.40, H: 5.78, N: 29.53.

15 Part C: The product of Part B from above was combined with 4-acetyl-2-bromoaniline in a manner similar to Part C in Example 21, to yield the title compound as a pale yellow solid (mp 153-154 °C). Elemental analysis for C₁₈H₂₁BrN₆O: Theory C: 51.81, H: 5.07, N: 20.14. Found: C: 51.86, H: 5.87, N: 19.84.

Example 27

25 (+/-)-N-(4-acetyl-2-bromophenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: The product of Part D from Example 1 was treated with 2-amino-1-methoxybutane in a manner similar to Part A of Example 21, to yield 5-amino-4-chloro-6-(1-methoxy-2-butyl) amino-2-methylpyrimidine as an orange yellow solid (mp 128-130 °C).

35 Part B: The product of Part A from above was cyclized in a manner similar to Part E of Example 1 to yield 7-chloro-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]

pyrimidine as an off-white crystalline solid (mp 66-87 °C). Elemental analysis for C₁₀H₁₄ClN₅O: Theory C: 46.97, H: 5.53, N: 27.39. Found: C: 47.22, H: 5.43, N: 27.47.

5

Part C: The product of Part B from above was combined with 4-acetyl-2-bromoaniline in a manner similar to Part C in Example 21, to yield the title compound as a pale yellow solid (mp 133-134 °C).
10 Elemental analysis for C₁₈H₂₁BrN₆O₂: Theory C: 49.89, H: 4.90. Found: C: 50.13, H: 4.99.

Example 28

(+/-)-N-(4-bromo-2,6-dimethylphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
15

The product of Part B from Example 27 was combined with 4-bromo-2,6-dimethylaniline in a manner similar to Part C in Example 21, to yield the title compound as a white crystalline solid (mp 137-138 °C).
20 Elemental analysis for C₁₈H₂₃BrN₆O₂: Theory C: 51.56, H: 5.54, N: 20.04. Found: C: 51.75, H: 5.43, N: 19.99.

25

Example 29

(+/-)-N-(2,6-dimethyl-4-(methylthio)phenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
30

The product of Part B from Example 27 was combined with 2,6-dimethyl-4-methylthioaniline in a manner similar to Part C in Example 21, to yield the title compound as a white crystalline solid (mp 128-129 °C).
35 Elemental analysis for C₁₉H₂₆BrN₆OS: Theory C: 59.04, H: 6.78. Found: C: 58.49, H: 6.48.

Example 30

(+/-)-N-(2-bromo-4,6-dimethoxyphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

5

The product of Part B from Example 27 was treated with 2-bromo-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a white crystalline solid (mp 154-155 °C).

10 Elemental analysis for C₁₈H₂₃BrN₆O₃: Theory C: 47.90, H: 5.14, N: 18.62. Found: C: 48.28, H: 5.20, N: 18.91.

Example 31

15 (+/-)-N-(2-chloro-4,6-dimethoxyphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

The product of Part B from Example 27 was treated with 2-chloro-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a white crystalline solid (mp 149-150 °C). Elemental analysis for C₁₈H₂₃ClN₆O₃: Theory C: 53.14, H: 5.70 N: 20.66. Found: C: 53.36, H: 5.72, N: 20.49.

25

Example 32

(+/-)-3-[1-(1-methoxymethyl) propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

30

Part A: 4,6-Dichloro-2-methyl-5-nitropyrimidine (10 g, 48 mmol) dissolved in DMSO / water (480 ml / 48 ml) followed by addition of 2,4,6-trimethylaniline (7.43 ml, 52.8 mmol) dropwise via syringe over 30 minutes. The reaction was stirred at room temperature for 18 h and filtered. The solid was washed with water until the filtrant volume reached

35

600 ml. A 150 ml aliquat was removed, diluted with 1.5 liters water; 100 ml saturated brine, and extracted with 4 X 100 ml methylene chloride. This procedure was repeated until the remainder of the filtrant had been worked up. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered and concentrated *in-vacuo*. The crude solid was chromatographed on silica gel (350 g, 97/3 methylene chloride / methanol) to give the desired yellow crystalline product, 10.53 g (76%). ¹H NMR (CDCl₃, 300 MHz) δ 12.23 (bs, 1H), 10.60 (s, 1H), 6.95 (s, 2H), 2.34 (s, 3H), 2.33 (s, 3H), 2.16 (s, 6H).

Part B: The product from Part A (3.1 g, 11 mmol) was suspended in phosphorous oxychloride (25 ml) and heated to just under reflux for 1 h, to give a dark homogeneous reaction. The reaction was pipetted slowly and cautiously onto 700 ml ice/water, stirred 30 minutes at room temperature, diluted with 200 ml methylene chloride and transferred to a separatory funnel. The aqueous layer was extracted and reextracted with 3 X 50 ml methylene chloride. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered and concentrated *in-vacuo* to constant weight to afford 3.18 g (97%) of the product as a bright yellow solid. ¹H NMR (CDCl₃, 300 MHz) δ 8.79 (bs, 1H), 6.96 (s, 2H), 2.42 (s, 3H), 2.33 (s, 3H), 2.15 (s, 6H).

Part C: The product from Part B (2.73 g, 8.9 mmol) was suspended in 60 ml methanol, followed by addition of acetic acid (3.4 ml), cooling to 0 °C in an ice/acetone bath, and addition of iron (1.84 g). The heterogeneous reaction was stirred 5 minutes at 0 °C, then refluxed 3 h, cooled, and filtered through celite. The celite pad was washed with 500 ml ethyl acetate. The dark filtrate was concentrated *in-vacuo*.

to near dryness, redissolved in ethyl acetate / water and extracted. The aqueous layer was reextracted several times with ethyl acetate. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered and concentrated *in-vacuo*. Chromatography on silica gel (300 g, 1/1 ethyl acetate / hexanes) gave the product 2.18 g (88%) as an off-white solid. ¹H NMR (CDCl₃, 300 MHz) δ 6.93 (s, 2H), 6.25 (bs, 1H), 3.13 (bs, 2H), 2.36 (s, 3H), 2.31 (s, 3H), 2.17 (s, 6H).

Part D: The product from Part C (1.28 g, 4.60 mmol) was dissolved in methylene chloride (20 ml), followed by addition of 50% aq. acetic acid (14 ml) and sodium nitrite (338 mg, 4.89 mmol) in water (1ml). The reaction was stirred for 3 hours at room temperature, transferred to a separatory funnel, diluted with 100 ml water and 30 ml methylene chloride and extracted. The aqueous layer was reextracted with 3X30 ml methylene chloride. The combined organic layers were washed with brine, dried over anhydrous magnesium sulfate, filtered and concentrated *in vacuo*. Chromatography on silica gel (200 g, 2/8 ethyl acetate / hexanes) gave the product 1.32 g (88%) as an off-white crystalline solid, mp 186-188 °C. CI-HRMS calcd. for C₁₄H₁₅N₅Cl₁ (M+H): 288.1016. Found: 288.1008.

Part E: The product from Part D (425 mg, 1.48 mmol) was treated with triethylamine (0.247 ml, 1.78 mmol) and 2-amino-1-methoxy butane (0.183 ml, 1.78 mmol) in ethanol (10 ml) at reflux for 2 h. The reaction was concentrated directly to dryness *in vacuo*. Chromatography on silica gel (150 g, 1/2 hexanes / ethyl acetate) afforded the purified product, 392 mg (75%) as a crystalline solid, mp 156-157.5 °C. Anal. Calcd. for C₁₉H₂₆N₆O₁: C, 64.38; H,

7.39; N, 23.71. Found: C, 64.27; H, 7.47; N, 23.62.

Part P: The product from Part E (250 mg, 0.70 mmol) was treated with sodium hydride (42 mg, 1.40 mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 72 hours at room temperature, and 24 h at 50 °C, followed by dilution with 100 ml water and extraction with 3X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (50 g, 1/2 hexanes / ethyl acetate) afforded the purified product, 239 mg (96%) as a crystalline solid, mp 144.5-147 °C. Anal. Calcd. for C₁₉H₂₆N₆O₁: C, 64.38; H, 7.39; N, 23.71. Found: C, 64.32; H, 7.33; N, 23.78.

Example 33

(+/-)-N-ethyl-3-[1-(1-methoxy-methyl)propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

The product from Example 32, Part F (125 mg, 0.35 mmol) was treated with sodium hydride (13 mg, 0.42 mmol, 80%) and ethyl iodide (42 ml, 0.42 mmol) in dry dimethylformamide (3 ml) and stirred at room temperature for 48 h. The reaction was diluted with 50 ml water, and extracted with 4X30 ml methylene chloride. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated in vacuo to dryness. Chromatography on silica gel (50 g, 3/2 hexanes / ethyl acetate) afforded the desired product, 111 mg (80%) as a clear viscous oil. CI-HRMS calcd. for C₂₁H₃₁N₆O₁ (M+H): 383.2559. Found: 383.2567.

Example 34

3-[1-(1-ethyl)propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

5 **Part A:** The product from Example 32, Part D (500 mg, 1.74 mmol) was treated with triethylamine (0.29 ml, 2.09 mmol) and 3-aminopentane (0.243 ml, 2.09 mmol) in ethanol (10 ml) at reflux for 2 h. The reaction was concentrated directly to dryness in
10 vacuo. Chromatography on silica gel (100 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 462 mg (79%) as a crystalline solid, mp 184.5-186.5 °C. Anal. Calcd. for C₁₉H₂₆N₆: C, 67.43; H, 7.74; N, 24.83. Found: C, 67.11; H, 7.59; N,
15 24.57.

Part B: The product from Part A (300 mg, 0.89 mmol) was treated with sodium hydride (53 mg, 1.78 mmol, 80%) in dry dimethylformamide (5 ml). The
20 reaction was stirred 72 hours at 50 °C, followed by dilution with 125 ml water and extraction with 3X40 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel
25 (75 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 239 mg (80%) as a crystalline solid, mp 160-162 °C. Anal. Calcd. for C₁₉H₂₆N₆: C, 67.43; H, 7.74; N, 24.83. Found: C, 67.07; H, 7.85; N, 24.51.

30

Example 35

(+/-)-3-[1-(1-ethyl)butyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

35

Part A: The product from Example 32, Part D (525 mg, 1.82 mmol) was treated with triethylamine

(0.305 ml, 3.64 mmol) and 3-aminoheptane (0.219 ml, 3.64 mmol) in ethanol (8 ml) at 50°C for 18 hours. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (140 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 450 mg (70%) as a crystalline solid, mp 170.5-172 °C. Anal. Calcd. for C₂₀H₂₈N₆: C, 68.15; H, 8.02; N, 23.84. Found: C, 68.10; H, 7.80; N, 23.94.

10

Part B: The product from Part A (300 mg, 0.85 mmol) was treated with sodium hydride (64 mg, 2.13 mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 24 hours at room temperature, and 24 hours at 50 °C, followed by dilution with 125 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (60 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 266 mg (89%) as a crystalline solid, mp 156-157.5 °C. Anal. Calcd. for C₁₉H₂₆N₆: C, 68.15; H, 8.01; N, 23.84. Found: C, 68.51; H, 8.10; N, 23.94.

25

Example 36

(+/-)-3-[1-(1-ethyl)pentyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidine-7-amine

30

Part A: The product from Example 32, Part D (500 mg, 1.74 mmol) was treated with triethylamine (0.290 ml, 4.35 mmol) and 3-aminoheptane (0.343 ml, 4.35 mmol) in ethanol (8 ml) at 50 °C for 18 h. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (125 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 465 mg (73%) as a crystalline solid, mp

35

141.5-142.5 °C. Anal. Calcd. for C₂₁H₃₀N₆: C, 68.82; H, 8.25; N, 22.93. Found: C, 69.11; H, 8.10; N, 23.04.

- 5 **Part B:** The product from Part A (300 mg, 0.82 mmol) was treated with sodium hydride (49 mg, 1.64 mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 24 hours at 50°C, followed by dilution with 125 ml water and extraction with 4X30 ml
10 ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (75 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 236 mg (79%) as a crystalline solid,
15 mp 129-130.5 °C. Anal. Calcd. for C₂₁H₃₀N₆: C, 68.82; H, 8.25; N, 22.93. Found: C, 68.73; H, 8.23; N, 22.90.

Example 37

- 20 **5-methyl-3-[1-(1-propyl)butyl]-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine**

- Part A:** The product from Example 32, Part D
25 (255 mg, 0.87 mmol) was treated with triethylamine (0.145 ml, 1.74 mmol) and 4-aminoheptane (0.120 ml, 1.74 mmol) in ethanol (5 ml) at 50°C for 18 hours. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (60 g, 8/2
30 hexanes / ethyl acetate) afforded the purified product, 233 mg (73%) as a crystalline solid, mp 145-146.5 °C. Anal. Calcd. for C₂₁H₃₀N₆: C, 68.82; H, 8.25; N, 22.93. Found: C, 69.09; H, 8.21; N, 23.04.

35

- Part B:** The product from Part A (230 mg, 0.63 mmol) was treated with sodium hydride (47 mg, 1.58

mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 24 hours at room temperature, and 24 h at 50 °C, followed by dilution with 125 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (60 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 211 mg (92%) as a crystalline solid, mp 143-144.5 °C. Anal. Calcd. for C₂₁H₃₀N₆: C, 68.82; H, 8.25; N, 22.93. Found: C, 69.08; H, 8.10; N, 23.03.

Example 38

3-(2-methoxyethyl)-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: The product from Example 32, Part D (1.07 g, 3.70 mmol) was treated with triethylamine (0.620 ml, 4.44 mmol) and 2-methoxyethylamine (0.386 ml, 4.44 mmol) in ethanol (20 ml) at reflux for 3 h. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (150 g, 1/1 hexanes / ethyl acetate) afforded the purified product, 1.18 g (97%) as a crystalline solid, mp 141.5-143.5 °C. Anal. Calcd. for C₁₇H₂₂N₆O₁: C, 62.56; H, 6.79; N, 25.75. Found: C, 62.54; H, 6.78; N, 25.70.

Part B: The product from Part A (325 mg, 1.00 mmol) was treated with sodium hydride (60 mg, 2.00 mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 72 hours at room temperature, and 24 hours at 50 °C, followed by dilution with 125 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness.

Chromatography on silica gel (50 g, 1/2 hexanes / ethyl acetate) afforded the purified product, 321 mg (99%) as a crystalline solid, mp 171.5-173.5 °C. Anal. Calcd. for C₁₇H₂₂N₆O₁: C, 62.56; H, 6.79.

5 Found: C, 62.24; H, 6.89.

Example 39

N-ethyl-3-(2-methoxyethyl)-5-methyl-*N*-(2,4,6-trimethylphenyl)-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

The product from Example 38, Part B (150 mg, 0.46 mmol) was treated with sodium hydride (17 mg, 0.55 mmol, 80%) and ethyl iodide (55 ml, 0.69 mmol) in dry dimethylformamide (3 ml) and stirred at room temperature for 48 h. The reaction was diluted with 50 ml water, and extracted with 4X30 ml methylene chloride. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated in vacuo to dryness. Chromatography on silica gel (50 g, 1/1 hexanes / ethyl acetate) afforded the desired product, 144 mg (88%) as a clear viscous oil. CI-HRMS calcd. for C₁₉H₂₇N₆O₁ (M+H): 355.2246. Found: 355.2240.

Example 40

N-(2-Methyl-4-bromophenyl)-3-[1-(1-propyl)butyl]-5-methyl-3*H*-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: 4,6-Dichloro-2-methyl-5-nitropyrimidine (5.2 g, 25 mmol) dissolved in DMSO (480 ml) followed by addition of 2-methyl-4-bromoaniline (4.65 g, 25 mmol) dropwise via syringe over 30 minutes. The reaction was stirred at RT for 18 h, followed by addition of 800 ml water. The resulting precipitate was filtered and dried to

constant weight affording 7.02 g (83%) of the desired pyrimidone as a yellow solid.

Part B: The product from Part A (6.95 g, 20.5 mmol) was treated with phosphorous oxychloride (120 ml) and brought to reflux for 20 minutes. The reaction was cooled, and slowly quenched on 3 L of ice/water. The resultant precipitate was filtered and dried. Chromatography on silica gel (500 g, 8/2 hexanes / ethyl acetate) gave the purified product, 5.4 g (74%), as a yellow solid.

Part C: The product from Part B (5.4 g, 15.2 mmol) was suspended in 120 ml methanol, followed by addition of acetic acid (6.8 ml), cooling to 0 °C in an ice/acetone bath, and addition of iron (4.23 g) under the same conditions described in Example 32, Part C. The resultant brown solid was used directly in the next reaction.

20

Part D: The product from Part C (15.2 mmol) was dissolved in methylene chloride (100 ml), followed by addition of 50% aq. acetic acid (50 ml) and sodium nitrite (1.15 g, 16.70 mmol) in water (5ml) under the same conditions described in Example 32, Part D. Chromatography of the crude product on silica gel (400 g, 2/8 ethyl acetate / hexanes) gave the product 3.15 g (62% from Part C) as an off-white crystalline solid, mp 145-147.5 °C.

30

Part E: The product from Part D (600 mg, 1.78 mmol) was treated with triethylamine (300 ml, 2.14 mmol) and 4-aminoheptane (246 ml, 2.14 mmol) in ethanol (10 ml) at 50 °C for 18 h. The reaction was concentrated directly to dryness *in vacuo*. Chromatography on silica gel (125 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 600 mg

35

(81%) as a crystalline solid, mp 155-156 °C. Anal. Calcd. for C₁₉H₂₅N₆Br₁: C, 54.68; H, 6.05; N, 20.14. Found: C, 54.36; H, 5.71; N, 20.24.

- 5 **Part P:** The product from Part E (350 mg, 0.84 mmol) was treated with sodium hydride (63 mg, 2.10 mmol, 80%) in dry dimethylformamide (5 ml). The reaction was stirred 24 h at room temperature, and 24 h at 50 °C, followed by dilution with 125 ml water and
10 extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (60 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 333 mg (95%) as a
15 crystalline solid, mp 126.5-128 °C. Anal. Calcd. for C₁₉H₂₅N₆Br₁: C, 54.68; H, 6.05; N, 20.14. Found: C, 54.90; H, 6.04; N, 20.40.

Example 41

- 20 (+/-)-3-[1-(1-ethyl)butyl]-5-methyl-N-(2-methyl-4-bromophenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

- Part A:** The product from Example 40, Part D
25 (600 mg, 1.78 mmol) was treated with triethylamine (0.300 ml, 2.14 mmol) and 3-aminohexane (0.214 ml, 2.14 mmol) in ethanol (10 ml) at 50 °C for 18 h. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (75 g, 8/2
30 hexanes / ethyl acetate) afforded the purified product, 616 mg (86%) as a crystalline solid, mp 117.5-119.5 °C. Anal. Calcd. for C₁₈H₂₃N₆Br₁: C, 53.60; H, 5.76; N, 20.84. Found: C, 53.53; H, 5.72; N, 20.95.

35

Part B: The product from Part A (450 mg, 1.12 mmol) was treated with sodium hydride (84 mg, 2.80

mmol, 80%) in dry dimethylformamide (10 ml). The reaction was stirred 72 hours at room temperature, followed by dilution with 125 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (75 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 425 mg (94%) as a crystalline solid, mp 99-101 °C.

10

Example 42

(+/-)-N-(4-bromo-2-methylphenyl)-3-[1-(1-methoxymethyl) propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

15

Part A: The product from Example 40, Part D (800 mg, 2.37 mmol) was treated with triethylamine (0.400 ml, 2.84 mmol) and 2-amino-1-methoxybutane (0.341 ml, 2.84 mmol) in ethanol (20 ml) at room temperature for 48 h. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (150 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 697 mg (72%) as a crystalline solid, mp 144.5-146 °C. Anal. Calcd. for C₁₇H₂₁N₆BrO₁: C, 50.38; H, 5.22; N, 20.74. Found: C, 50.35; H, 5.23; N, 20.58.

Part B: The product from Part A (550 mg, 1.36 mmol) was treated with sodium hydride (102 mg, 3.40 mmol, 80%) in dry dimethylformamide (8 ml). The reaction was stirred 72 h at room temperature, followed by dilution with 125 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (75 g, 8/2 hexanes / ethyl acetate) afforded the purified product, 520 mg (94%) as a crystalline solid.

Example 43

(+/-)-3-[1-(1-ethyl)pentyl]-5-methyl-N-[(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

5

Part A: To 2,4-dichloro-2-methyl-5-nitropyrimidine (10.10 g, 48.60 mmol) in dry tetrahydrofuran (200 ml) and triethylamine (5.8 ml, 48.6 mmol) was added 3-amino-2,4,6-trimethylpyridine
10 (3.30 g, 24.3 mmol) in tetrahydrofuran (30 ml) via canulation over 10 minutes at room temperature. The reaction was stirred 72 h, diluted with 1 L of water, and extracted with 4X200 ml ethyl acetate. The combined organic extracts were dried over anhydrous
15 magnesium sulfate, filtered, and concentrated to dryness in vacuo. Chromatography on silica gel (300 g, 1/1 ethyl acetate / hexanes) afforded the purified product, 4.8 g (64%) as a white solid. ¹H NMR (300 MHz, CDCl₃) δ 8.79 (bs, 1H), 6.97 (s, 1H), 2.54 (s, 3H), 2.43 (s, 3H), 2.40 (s, 3H), 2.17 (s, 3H).
20

Part B: The product from Part A (4.8 g, 15.60 mmol) was treated with iron (4.36 g, 78.00 mmol) in methanol (110 ml) and acetic acid (6 ml) under the
25 same reaction conditions described in Example 32, Part C. Chromatography on silica gel (250 g, 9/1 methylene chloride / methanol) afforded the purified reduction product, 3.1 g, (72%) as a white solid. ¹H NMR (300 MHz, CDCl₃) δ 6.94 (s, 1H), 6.26 (bs, 1H), 3.36 (bs, 1H), 2.52 (s, 3H), 2.41 (s, 3H), 2.35 (s, 3H), 2.16 (s, 3H).
30

Part C: The product from Part B (2.1 g, 7.56 mmol) was treated with sodium nitrite (574 mg, 8.32
35 mmol) in methylene chloride (44 ml) and 50% aq. acetic acid (25 ml) under the same reactions conditions described in Example 32, Part D. Chromatography on

silica gel (125 g, 1/1 ethyl acetate / hexanes)
afforded the purified cyclized product, 1.7 g (78%) as
a white solid, mp 204.5-206°C. Anal. Calcd. for
C₁₃H₁₃N₆Cl₁: C, 54.08; H, 4.55; N, 29.11. Found:
5 C, 53.94; H, 4.43; N, 28.79.

Part D: The product from Part C (300 mg, 1.04
mmol) was treated with triethylamine (175 ml, 1.25
mmol) and 3-aminoheptane (243 ml, 1.25 mmol) in
10 ethanol (10 ml) at reflux for 2.5 hours. The reaction
was concentrated directly to dryness in vacuo.
Chromatography on silica gel (20 g, 1/2 hexanes /
ethyl acetate) afforded the purified product, 356 mg
(93%) as a crystalline solid, mp 122-130°C. Anal.
15 Calcd. for C₂₀H₂₉N₇: C, 65.37; H, 7.95; N, 26.68.
Found: C, 65.35; H, 7.95; N, 26.82.

Part E: The product from Part D (160 mg, 0.44
mmol) was treated with sodium hydride (27 mg, 0.88
20 mmol, 80%) in dry dimethylformamide (4 ml). The
reaction was stirred 24 hours at room temperature, and
100 hours at 50°C, followed by dilution with 100 ml
water and extraction with 3X30 ml ethyl acetate. The
combined organics were dried over anhydrous magnesium
25 sulfate, filtered, and concentrated to dryness.
Preparative HPLC [(25-65%) acetonitrile :
trifluoroacetic acid / water : trifluoroacetic acid,
Dynamax C18 column] afforded the purified product, 60
mg (38%) as an amorphous foam. CI-HRMS calcd. for
30 C₂₀H₂₉N₇ (M+H): 368.2545. Found: 368.2563.

Example 44

(+/-)-N-ethyl-3-[1-(1-ethyl) pentyl]-5-methyl-
N-[(2,4,6-trimethyl)-3-pyridyl]-1,3H-1,2,3-
35 triazolo[4,5-d]pyrimidin-7-amine

The product from Example 43, Part E (29 mg, 0.08 mmol) was treated with sodium hydride (3 mg, 0.1 mmol, 80%) and ethyl iodide (9.6 ml, 0.12 mmol) in dry dimethylformamide (1 ml) and stirred at room temperature for 168 h. The reaction was diluted with 10 ml water, and extracted with 4X5 ml ethyl acetate. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated *in vacuo* to dryness. Chromatography on silica gel (10 g, 1/1 hexanes / ethyl acetate) afforded the desired product, 19.7 mg (63%) as a clear viscous oil. CI-HRMS calcd. for C₂₂H₃₃N₇ (M+H): 396.2876. Found: 396.2876.

Example 45

(+/-)-3-[1-(1-ethyl)butyl]-5-methyl-N-[(2,4,6-trimethyl)3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: The product from Example 43, Part C (546 mg, 1.89 mmol) was treated with triethylamine (0.316 ml, 2.27 mmol) and 3-aminohexane (0.210 mg, 2.07 mmol) in ethanol (15 ml) at reflux for 2.5 h. The reaction was concentrated directly to dryness *in vacuo*. Chromatography on silica gel (50 g, ethyl acetate) afforded the purified product, 530 mg (79%) as a crystalline solid, mp 155.5-158 °C. Anal. Calcd. for C₁₉H₂₇N₇: C, 64.56; H, 7.71; N, 27.74. Found: C, 64.59; H, 7.62; N, 27.91.

Part B: The product from Part A (400 mg, 1.13 mmol) was treated with sodium hydride (94 mg, 3.11 mmol, 80%) in dry dimethylformamide (12 ml). The reaction was stirred 72 h at 50 °C, followed by dilution with 100 ml water and extraction with 4X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and

concentrated to dryness. Chromatography on silica gel (50 g, 1/3 hexanes / ethyl acetate) afforded the purified product, 355 mg (89%) as a crystalline solid, mp 132-140.5 °C. Anal. Calcd. for C₁₉H₂₇N₇: C, 64.56; H, 7.71; N, 27.74. Found: C, 64.52; H, 7.58; N, 27.97.

Example 46

N-ethyl-3-[1-(1-ethyl)butyl]-5-methyl-N-[(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

The product from Example 45, Part B (250 mg, 0.71 mmol) was treated with sodium hydride (26 mg, 0.85 mmol, 80%) and ethyl iodide (0.85 ml, 1.07 mmol) in dry dimethylformamide (7 ml) and stirred at room temperature for 15 h. The reaction was diluted with 150 ml water, and extracted with 3X30 ml ethyl acetate. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated in vacuo to dryness. Chromatography on silica gel (20 g, 1/3 hexanes / ethyl acetate) afforded the desired product, 221 mg (81%) as a clear viscous oil.

Example 47

3-[1-(1-propyl)butyl]-5-methyl-N-[(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

Part A: The product from Example 43, Part C (700 mg, 2.42 mmol) was treated with triethylamine (0.405 ml, 2.91 mmol) and 4-aminoheptane (335 mg, 2.91 mmol) in ethanol (20 ml) at reflux for 2.5 h. The reaction was concentrated directly to dryness in vacuo. Chromatography on silica gel (50 g, 1/3 hexanes / ethyl acetate) afforded the purified

product, 845 mg (96%) as a crystalline solid, mp 135.5-137.5 °C. Anal. Calcd. for C₂₀H₂₉N₇: C, 65.37; H, 7.95; N, 26.68. Found: C, 65.71; H, 7.70; N, 26.95.

5

Part B: The product from Part A (600 mg, 1.63 mmol) was treated with sodium hydride (147.5 mg, 4.89 mmol, 80%) in dry dimethylformamide (15ml). The reaction was stirred 15 h at 50 °C, followed by
10 dilution with 200 ml water and extraction with 5X30 ml ethyl acetate. The combined organics were dried over anhydrous magnesium sulfate, filtered, and concentrated to dryness. Chromatography on silica gel (50 g, 1/3 hexanes / ethyl acetate) afforded the
15 purified product, 560 mg (93%) as a crystalline solid, mp 128-130 °C. CI-HRMS calcd. for C₂₀H₂₉N₇ (M+H): 368.2561. Found: 368.2563.

Example 48

20 **N-ethyl-3-[1-(1-propyl) butyl]-5-methyl-N-[(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine**

The product from Example 47, Part B (400 mg, 1.09 mmol) was treated with sodium hydride (40 mg, 1.31 mmol, 80%) and ethyl iodide (0.130 ml, 1.63 mmol) in dry dimethylformamide (10 ml) and stirred at room temperature for 15 hours. The reaction was diluted with 150 ml water, and extracted with 3X30 ml ethyl
30 acetate. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated in vacuo to dryness. Chromatography on silica gel (20 g, 1/3 hexanes / ethyl acetate) afforded the desired product, 373 mg (87%) as a clear
35 viscous oil.

Example 49

(+/-)-3-[1-(1-methoxymethyl) propyl]-5-methyl-
N-[(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-
triazolo[4,5-d]pyrimidin-7-amine

5 **Part A:** The product from Example 43, Part C
(700 mg, 2.42 mmol) was treated with triethylamine
(0.405 ml, 2.91 mmol) and 2-aminomethoxybutane (0.350
ml, 2.91 mmol) in ethanol (20 ml) at reflux for 2.5 h.
The reaction was concentrated directly to dryness in
10 vacuo. Chromatography on silica gel (50 g, 1/1
hexanes / tetrahydrofuran) afforded the purified
product, 845 mg (98%) as a crystalline solid, mp 132-
136.5 °C. Anal. Calcd. for C₁₈H₂₅N₇O₁: C, 60.82; H,
7.1; N, 27.58. Found: C, 61.13; H, 6.89; N,
15 27.54.

Part B: The product from Part A (600 mg, 1.68
mmol) was treated with sodium hydride (151.2 mg, 5.04
mmol, 80%) in dry dimethylformamide (15ml). The
20 reaction was stirred 15 hours at 50 °C, followed by
dilution with 100 ml water and extraction with 4X30 ml
ethyl acetate. The combined organics were dried over
anhydrous magnesium sulfate, filtered, and
concentrated to dryness. Chromatography on silica gel
25 (50 g, 1/1 hexanes / tetrahydrofuran) afforded the
purified product, 500 mg (83%) as a crystalline solid,
mp 141.5-144 °C. Anal. Calcd. for C₁₈H₂₅N₇O₁: C,
60.82; H, 7.1; N, 27.58. Found: C, 60.94; H,
6.95; N, 27.46.

30

Example 50

(+/-)-N-ethyl-3-[1-(1-methoxy methyl)propyl]-5-
methyl-N-[(2,4,6-trimethyl)-3-pyridyl]-3H-
1,2,3-triazolo[4,5-d]pyrimidin-7-amine

35

The product from Example 49, Part B (350 mg,
0.99 mmol) was treated with sodium hydride (36 mg,

1.19 mmol, 80%) and ethyl iodide (0.119 ml, 1.49mmol) in dry dimethylformamide (10 ml) and stirred at room temperature for 15 h. The reaction was diluted with 150 ml water, and extracted with 3X30 ml ethyl acetate. The combined organic extracts were dried over anhydrous magnesium sulfate, filtered, and concentrated *in vacuo* to dryness. Chromatography on silica gel (20 g, 1/1 hexanes / tetrahydrofuran) afforded the desired product, 338 mg (89%) as a clear viscous oil.

Example 51

N-(2,4-dibromophenyl)-5-methyl-3-(1-propyl)butyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine

Part A: 4-Aminoheptane (2.5 g) was added to a solution of 4,6-ditosyloxy-2-methyl-5-nitropyrimidine (10.5 g) and *N,N*-diisopropylethylamine (3.8 mL) in dichloromethane (219 mL). The reaction was stirred under nitrogen for 5 h at room temperature and then extracted with water. The organic layer was dried over anhydrous magnesium sulfate and concentrated to yield *N*-(1-propyl)butyl-2-methyl-5-nitro-4-tosyloxy-4,6-dihydropyrimidin-6-amine as a pale yellow solid (9.1 g).

Part B: The product of part A (9.0 g), anhydrous toluene (200 mL), *N,N*-diisopropylethylamine (3.8 mL) and 2,4-dibromoaniline (5.5 g) were heated at 65 °C for 16 h under nitrogen. The reaction was added to saturated aqueous NH₄Cl and extracted with dichloromethane (3 times). The combined organic layers were dried over anhydrous magnesium sulfate and concentrated to yield *N*-4-(2,4-dibromophenyl)-*N*-(5-(1-propyl)butyl)-2-methyl-5-nitro-pyrimidin-4,6-diamine as a yellow solid (6.5 g).

Part C: The product of part B (6.5 g), 1,4-dioxane (65 mL), water (65 mL), sodium dithionite (18.0 g) and 40% ammonium hydroxide (6.5 mL) were stirred for 3 h at room temperature. The reaction mixture was added to saturated aqueous NH_4Cl and extracted with ethyl acetate (3 times). The combined organic layers were dried over anhydrous magnesium sulfate and concentrated. The residue was purified by flash column chromatography on silica gel using EtOAc/hexane (2:8) to yield *N*-[4-(2,4-dibromophenyl)]-*N*-[6-(1-propyl)butyl]-2-methyl-5-aminopyrimidin-4,6-diamine as a pale yellow solid (5.1 g).

Part D: The product of part C (5.0 g) was dissolved in a 2:1:1 mixture of dichloromethane, acetic acid and water. To this solution was added sodium nitrite (0.9 g) and the resulting solution was stirred for 2 h at room temperature. The reaction was added to an equal volume of water and extracted with dichloromethane (3 times). The combined organic layers were washed with saturated aqueous NaHCO_3 , then were dried over anhydrous magnesium sulfate and concentrated. The residue was purified by flash column chromatography on silica gel using ethyl acetate/hexane (2:8) to yield *N*-(1-propyl)butyl-3-(2,4-dibromophenyl)-5-methyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine as a white solid (3.9 g). A small amount of the title compound, *N*-(2,4-dibromophenyl)-5-methyl-3-(1-propyl)butyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-7-amine (0.18 g) was also isolated from the chromatography.

Part E: Sodium hydride (0.24 g) was added to a solution of the product of part D (3.9 g) in anhydrous DMF (82 mL). The resulting solution was stirred for 16 h under nitrogen and the partitioned between ethyl

acetate and water. The organic layer was washed with
brine, dried over anhydrous magnesium sulfate and
concentrated. The resulting solid was recrystallized
from boiling 2-propanol to afford the title compound
5 as a white crystalline solid (3.6 g).

Example 52

N-[4-acetyl-2-bromophenyl]-5-methyl-3-(1-
propyl)butyl-3*H*-1,2,3-triazolo[4,5-*d*]pyrimidin-
10 7-amine

Bis(triphenylphosphine)palladium dichloride
(11.9 mg), tetrakis(triphenylphosphine)palladium
(19.6 mg) and 1-ethoxyvinyltributyltin (299 mg) were
15 added to the product of Part E, from Example 51 (0.33
g) dissolved in toluene (5 mL). The reaction was
heated to reflux and stirred overnight. The solvent
was then removed under vacuum and the residue
partitioned between ether and aqueous saturated NaF.
20 The mixture was then filtered and separated. The
organic layer was then washed with 1*N* HCl, dried over
anhydrous magnesium sulfate and concentrated. The
residue was purified by flash column chromatography on
silica gel using ethyl acetate/hexane (2:8) to yield
25 the title compound.

30

Example 53

N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-(*N,N*-
dimethylamino-methyl)butyl]-5-methyl-3*H*-1,2,3-
triazolo[4,5-*d*]pyrimidin-7-amine

35

Part A: A solution of *N*-CBZ-*d*, 1-norvaline
(TCI America) in THF (0.5 M) is treated in sequence
with 1-hydroxybenzotriazole hydrate (1.2 eq),

dimethylamine hydrochloride (1.3 eq), triethylamine (1.4 eq), and dicyclohexylcarbodiimide (1.2 eq). After stirring overnight, the mixture is filtered, which is followed by aqueous workup and chromatography, to
5 afford N,N-dimethyl-N'-CBZ-d,l-norvalinamide, as an oil (TLC Rf = 0.10, 30:70 ethyl acetate-hexane).

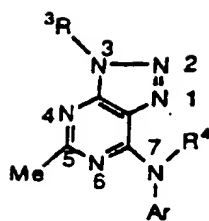
Part B: A solution of the CBZ compound from Part A above is dissolved in methanol (1 M), and 5% Pd
10 on carbon is added. The mixture is submitted to hydrogenation in the usual Parr shaker apparatus (50 PSI, overnight). The resulting mixture is filtered through celite and evaporated to afford sufficiently pure product, N,N-dimethyl-d,l-norvalinamide, as an
15 oil (TLC baseline in 30:70 ethyl acetate-hexane).

Part C: The amine from Part B is elaborated to title compound by using the procedure outlined in Example 32 or 51. Spectral data. ¹H NMR (300 MHz, CDCl₃): d 8.61 (1H, d, J = 8.4 Hz), 8.20 (1H, br s),
20 7.48 (1H, d, J = 1.8 Hz), 7.26 (1H, dd, J = 8.4, 1.8 Hz), 5.08-4.98 (1H, m), 3.27 (1H, dd, J = 12.6, 9.7 Hz), 2.91 (1H, heptet, J = 7.0 Hz), 2.68 (3H, s), 2.67 (1H, dd, J = 12.6 Hz), 2.22 (6H, s), 2.21-2.11 (1H, m),
25 1.99-1.89 (1H, m), 1.29-1.19 (1H, m), 1.27 (6H, d, J = 7.0 Hz), 1.16-1.05 (1H, m), 0.88 (3H, t, J = 7.1 Hz). MS(NH₃-CI): m/e 464 (3), 463 (25), 462 (100), 461 (29), 460 (98).

30 The compounds of Examples 54-208 can be made by the methods exemplified in Examples 1-53.

Table 1

35 3H-1,2,3-triazolo[4,5-d]pyrimidines:



Ex	No.	Ar	R ³	R ⁴
5	54	2-Br-4-i-Pr-Ph	C(Me) ₂ CH ₂ -OCH ₃	H
	55	2-Br-4-i-Pr-Ph	cyclopentyl	H
	56	2-Br-4,6-(OMe) ₂ -Ph	CH(Bz)CH ₂ -OCH ₃	H
	57	2-Cl-4,6-(OMe) ₂ -Ph	CH(Bz)CH ₂ -OCH ₃	H
10	58	4-i-Pr-2-SMe-Ph	CH(Bz)CH ₂ -OCH ₃	H
	59	4-i-Pr-2-SO ₂ Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
	60	4-(COMe)-2-Br-Ph	CH(Bz)CH ₂ -OCH ₃	H
	61	2-Br-4-CF ₃ -Ph	CH(Bz)CH ₂ -OCH ₃	H
	62	4-Br-2,6-(Me) ₂ -Ph	CH(Bz)CH ₂ -OCH ₃	H
15	63	2,6-(Me) ₂ -4-SO ₂ Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
	64	2,4,6-(Me) ₃ -Ph	CH(Bz)CH ₂ -OCH ₃	H
	65	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(Bz)CH ₂ -OCH ₃	H
	66	2-Br-4,6-(Me) ₂ -Ph	CH(Bz)CH ₂ -OCH ₃	H
	67	4-Br-2-Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
20	68	4-N(Et) ₂ -2-Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
	69	4-I-2-Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
	70	2-I-4-i-Pr-Ph	CH(Bz)CH ₂ -OCH ₃	H
	71	2-Br-4-SMe-Ph	CH(Bz)CH ₂ -OCH ₃	H
	72	2-Br-4-SO ₂ Me-Ph	CH(Bz)CH ₂ -OCH ₃	H
25	73	2-Br-4-N(Me) ₂ -6-OMe-Ph	CH(Bz)CH ₂ -OCH ₃	H
	74	2-Br-4,6-(OMe) ₂ -Ph	CH(Et)Bu ⁿ	H
	75	2-Cl-4,6-(OMe) ₂ -Ph	CH(Et)Bu ⁿ	H
	76	4-i-Pr-2-SMe-Ph	CH(Et)Bu ⁿ	H
	77	4-i-Pr-2-SO ₂ Me-Ph	CH(Et)Bu ⁿ	H
30	78	4-(COMe)-2-Br-Ph	CH(Et)Bu ⁿ	H
	79	2-Br-4-CF ₃ -Ph	CH(Et)Bu ⁿ	H
	80	4-Br-2,6-(Me) ₂ -Ph	CH(Et)Bu ⁿ	H

	81	2,6-(Me) ₂ -4-SO ₂ Me-Ph	CH(Et)Bu ⁿ	H
	82	2,6-(Me) ₂ -4-SMe-Ph	CH(Et)Bu ⁿ	H
	83	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(Et)Bu ⁿ	H
	84	2-Br-4,6-(Me) ₂ -Ph	CH(Et)Bu ⁿ	H
5	85	4-Br-2-Me-Ph	CH(Et)Bu ⁿ	H
	86	4-N(Et) ₂ -2-Me-Ph	CH(Et)Bu ⁿ	H
	87	4-I-2-Me-Ph	CH(Et)Bu ⁿ	H
	88	2-I-4-i-Pr-Ph	CH(Et)Bu ⁿ	H
	89	2-Br-4-SO ₂ Me-Ph	CH(Et)Bu ⁿ	H
10	90	2-Br-4-N(Me) ₂ -6-OMe-Ph	CH(Et)Bu ⁿ	H
	91	2,4-[SMe] ₂ -Ph	CH(Et)Bu ⁿ	H
	92	2,4-[SO ₂ Me] ₂ -Ph	CH(Et)Bu ⁿ	H
	93	2-Br-4,6-(OMe) ₂ -Ph	CH(Et)Pr ⁿ	H
	94	2-Cl-4,6-(OMe) ₂ -Ph	CH(Et)Pr ⁿ	H
15	95	4-i-Pr-2-SMe-Ph	CH(Et)Pr ⁿ	H
	96	4-i-Pr-2-SO ₂ Me-Ph	CH(Et)Pr ⁿ	H
	97	4-(COMe)-2-Br-Ph	CH(Et)Pr ⁿ	H
	98	4-Br-2-CF ₃ -Ph	CH(Et)Pr ⁿ	H
	99	4-Br-2,6-(Me) ₂ -Ph	CH(Et)Pr ⁿ	H
20	100	2,6-(Me) ₂ -4-SMe-Ph	CH(Et)Pr ⁿ	H
	101	2,6-(Me) ₂ -4-SO ₂ Me-Ph	CH(Et)Pr ⁿ	H
	102	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(Et)Pr ⁿ	H
	103	2-Br-4,6-(Me) ₂ -Ph	CH(Et)Pr ⁿ	H
	104	4-N(Et) ₂ -2-Me-Ph	CH(Et)Pr ⁿ	H
25	105	2-I-4-i-Pr-Ph	CH(Et)Pr ⁿ	H
	106	2-Br-4-SMe-Ph	CH(Et)Pr ⁿ	H
	107	2-Br-4-SO ₂ Me-Ph	CH(Et)Pr ⁿ	H
	108	2-Br-4,6-(OMe) ₂ -Ph	CH(C ₂ H ₅) ₂	H
	108	(m.p. 163-165 °C)		
30	109	2-Cl-4,6-(OMe) ₂ -Ph	CH(C ₂ H ₅) ₂	H
	109	(m.p. 166-167 °C)		
	110	4-i-Pr-2-SMe-Ph	CH(C ₂ H ₅) ₂	H
	110	(m.p. 89-90 °C)		
	111	4-i-Pr-2-SO ₂ Me-Ph	CH(C ₂ H ₅) ₂	H
35	112	4-(COMe)-2-Br-Ph	CH(C ₂ H ₅) ₂	H
	113	2-Br-4-CF ₃ -Ph	CH(C ₂ H ₅) ₂	H
	114	4-Br-2,6-(Me) ₂ -Ph	CH(C ₂ H ₅) ₂	H

	114	(m.p. 160-162 °C)		
	115	2,6-(Me) ₂ -4-SMe-Ph	CH(C ₂ H ₅) ₂	H
	116	2,6-(Me) ₂ -4-SO ₂ Me-Ph	CH(C ₂ H ₅) ₂	H
	117	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(C ₂ H ₅) ₂	H
5	118	2-Br-4,6-(Me) ₂ -Ph	CH(C ₂ H ₅) ₂	H
	119	4-N(Et) ₂ -2-Me-Ph	CH(C ₂ H ₅) ₂	H
	120	4-I-2-Me-Ph	CH(C ₂ H ₅) ₂	H
	121	2-I-4-i-Pr-Ph	CH(C ₂ H ₅) ₂	H
	122	2-Br-4-SMe-Ph	CH(C ₂ H ₅) ₂	H
10	123	2-Br-4-SO ₂ Me-Ph	CH(C ₂ H ₅) ₂	H
	124	2-Br-4-N(Me) ₂ -6-OMe-Ph	CH(C ₂ H ₅) ₂	H
	125	2,4-[S(O) ₂ Me] ₂ -Ph	CH(C ₂ H ₅) ₂	H
	126	2-Cl-4,6-(OMe) ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	127	4-i-Pr-2-S(O) ₂ Me-Ph	CH(n-C ₃ H ₇) ₂	H
15	128	4-(COMe)-2-Br-Ph	CH(n-C ₃ H ₇) ₂	H
	129	4-Br-2-CF ₃ -Ph	CH(n-C ₃ H ₇) ₂	H
	130	4-Br-2,6-(Me) ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	131	2,6-(Me) ₂ -4-S(O) _n Me-Ph	CH(n-C ₃ H ₇) ₂	H
	132	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(n-C ₃ H ₇) ₂	H
20	133	2-Br-4,6-(Me) ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	134	4-Cl-2-Me-Ph	CH(n-C ₃ H ₇) ₂	H
	135	4-N(Et) ₂ -2-Me-Ph	CH(n-C ₃ H ₇) ₂	H
	136	4-I-2-Me-Ph	CH(n-C ₃ H ₇) ₂	H
	137	2-I-4-i-Pr-Ph	CH(n-C ₃ H ₇) ₂	H
25	138	2-Br-4-N(Me) ₂ -6-OMe-Ph	CH(n-C ₃ H ₇) ₂	H
	139	2,4-[SMe] ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	140	2,4-[S(O)Me] ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	141	2,4-[S(O) ₂ Me] ₂ -Ph	CH(n-C ₃ H ₇) ₂	H
	142	4-i-Pr-2-S(O) _n Me-Ph	CH(Et)CH ₂ -OCH ₃	H
30	143	2-Br-4-CF ₃ -Ph	CH(Et)CH ₂ -OCH ₃	H
	144	2,6-(Me) ₂ -4-S(O)Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	145	2,6-(Me) ₂ -4-S(O) ₂ Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	146	2,6-(Me) ₂ -4-CF ₃ -Ph	CH(Et)CH ₂ -OCH ₃	H
	147	2,6-(Et) ₂ -4-Br-Ph	CH(Et)CH ₂ -OCH ₃	H
35	148	2-Br-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	148	(m.p. 156-157 °C)		
	149	4-Cl-2-Me-Ph	CH(Et)CH ₂ -OCH ₃	H

	150	4-N(Et) ₂ -2-Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	151	4-I-2-Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	151	(m.p. 122-123 °C)		
	152	2-I-4-i-Pr-Ph	CH(Et)CH ₂ -OCH ₃	H
5	153	2-Br-4-SMe-Ph	CH(Et)CH ₂ -OCH ₃	H
	154	2-Br-4-S(O) ₂ Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	155	2-Br-4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	156	2-Me-4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	156	(m.p. 159-162 °C)		
10	157	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	158	2-Br-4-OMe-Ph	CH(Et)CH ₂ -OCH ₃	H
	159	2-N(Me) ₂ -4-Me-Ph	CH(Et)CH ₂ -OCH ₃	H
	160	2-MeS-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	161	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
15	162	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	163	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	H
	164	2-Br-4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
	165	2-Me-4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
	166	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
20	167	2-Br-4-OMe-Ph	CH(Et)CH ₂ -OCH ₃	Et
	168	2-N(Me) ₂ -4-Me-Ph	CH(Et)CH ₂ -OCH ₃	Et
	169	2-MeS-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
	170	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
	171	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
25	172	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ -OCH ₃	Et
	173	2-Br-4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	174	2-Me-4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	175	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	176	2-Br-4-OMe-Ph	CH(CH ₂ -OCH ₃) ₂	H
30	177	2-N(Me) ₂ -4-Me-Ph	CH(CH ₂ -OCH ₃) ₂	H
	178	2-MeS-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	179	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	180	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
	181	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	H
35	182	2-Br-4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
	183	2-Me-4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
	184	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et

	185	2-Br-4-OMe-Ph	CH(CH ₂ -OCH ₃) ₂	Et
	186	2-N(Me) ₂ -4-Me-Ph	CH(CH ₂ -OCH ₃) ₂	Et
	187	2-MeS-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
	188	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
5	189	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
	190	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(CH ₂ -OCH ₃) ₂	Et
	191	2-Br-4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	192	2-Me-4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	193	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
10	194	2-Br-4-OMe-Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	195	2-N(Me) ₂ -4-Me-Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	196	2-MeS-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	197	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	198	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
15	199	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	H
	200	2-Br-4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	201	2-Me-4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	202	2,6-(Me) ₂ -4-NMe ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	203	2-Br-4-OMe-Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
20	204	2-N(Me) ₂ -4-Me-Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	205	2-MeS-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	206	2-MeS(O)-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	207	2-MeS(O) ₂ -4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et
	208	2-(CH ₃ CO)-4,6-(Me) ₂ -Ph	CH(CH ₂ -CH ₂ -CH ₃) ₂	Et

25

Example 209

N-[2-bromo-4-(1-methylethyl)phenyl]-2-methyl-9-(1-propylbutyl)-9H-purin-6-amine

30 **Part A:** The product of Part A (0.74 g) from Example 21 was treated with triethyl orthoformate (7.68 g) and con. H₂SO₄ (3 drops) and heated to 100 °C for 4h. The excess triethyl orthoformate was removed in vacuum, and the residue was purified by flash
 35 column chromatography to yield 6-chloro-2-methyl-9-(1-propylbutyl)-9H-purine as a colorless liquid (0.32 g).

Part B: The product of Part A from above was combined with 2-bromo-4-isopropylaniline in a manner similar to Part C of Example 21 to afford the title compound as a brown oil. Elemental analysis for
5 C₂₂H₃₀BrN₅: Theory C: 59.46, H: 6.80 N: 15.76. Found: C: 59.56, H: 6.83, N: 15.67.

Example 210

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-9-(1-
10 ethylpentyl)-2-methyl-9H-purin-6-amine

Part A: The product of Part D from Example 1 was treated with 3-aminoheptane in a manner similar to Part A of Example 21, to yield 5-amino-4-chloro-6-
15 (3-heptyl)amino-2-methylpyrimidine as a white crystalline solid (mp 116-117 °C). Elemental analysis for C₁₂H₂₁ClN₄: Theory C: 56.13, H: 8.24, N: 21.82. Found: C: 56.16, H: 8.26, N: 21.82

20 **Part B:** The product of Part A from above was treated with triethyl orthoformate in a manner similar to Part A of Example 209 to yield 6-chloro-9-(1-ethylpentyl)-2-methyl-9H-purine as a pale yellow liquid.

25 **Part C:** The product of Part B from above was combined with 2-bromo-4-isopropylaniline in a manner similar to Part C of Example 21 to afford the title compound as a colorless oil. Elemental analysis for
30 C₂₂H₃₀BrN₅: Theory C: 59.46, H: 6.80 N: 15.76. Found: C: 59.30, H: 6.82, N: 15.50.

Example 211

(+/-)-N-[2-bromo-4-(trifluoromethyl)phenyl]-9-
35 [1-(methoxymethyl)propyl]-2-methyl-9H-purin-6-amine

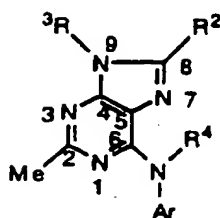
Part A: The product of Part A from Example 27 was treated with triethyl orthoformate in a manner similar to Part A of Example 209 to yield 6-chloro-9-[1-(methoxymethyl)propyl]-2-methyl-9H-purine as a
5 white crystalline solid (mp 105-106 °C). Elemental analysis for C₁₁H₁₅ClN₄O: Theory C: 51.87, H: 5.95 N: 22.00. Found: C: 51.85, H: 5.81, N: 21.96.

Part B: The product of Part A from above was
10 combined with 2-bromo-4-trifluoromethylaniline in a manner similar to Part C of Example 21 to afford the title compound as a off-white solid (mp 123-124 °C). Elemental analysis for C₁₈H₁₉BrF₃N₅O: Theory C: 47.18, H: 4.19, N: 15.28. Found: C: 47.28, H: 3.97, N:
15 15.50.

The compounds of Examples 212-217 can be made by methods exemplified in Examples 209-211.

Table 2

9H-imidazo[4,5-d]pyrimidines:



Ex.	No.	Ar	R ²	R ³	R ⁴
10	212	2-Br-4-i-Pr-Ph	Me	CH(n-C ₃ H ₇) ₂	H
	213	2,4,6-(Me) ₃ -Ph	Me	CH(n-C ₃ H ₇) ₂	H
	214	4-Br-2,6-(Me) ₂ -Ph	Me	CH(n-C ₃ H ₇) ₂	H
	215	2-Br-4-i-Pr-Ph	Me	CH(Et)CH ₂ OCH ₃	H
15	216	2,4,6-(Me) ₃ -Ph	Me	CH(Et)CH ₂ OCH ₃	H
	217	4-Br-2,6-(Me) ₂ -Ph	Me	CH(Et)CH ₂ OCH ₃	H

Example 218

20 *N*-[2-bromo-4-(1-methylethyl)phenyl]-*N*-ethyl-5-methyl-[1,2,3]thiadiazolo[5,4-*d*]pyrimidin-7-amine

Part A: The product of Part E (1.1 g) from Example 1 was dissolved in ethanol (15 mL) and added
 25 thiourea (0.27 g). The reaction mixture was refluxed for 1h, removed the solvent in vacuum, partitioned between CH₂Cl₂ and water, washed with brine, dried and stripped down to a residue. The residue was purified
 30 by flash column chromatography (CH₂Cl₂) to furnish the title compound as a white crystalline solid (1.01 g, mp 81-82 °C). Elemental analysis for C₁₄H₁₄BrN₅S:
 Theory C: 46.16, H: 3.87, N: 19.23, S: 8.80. Found:
 C: 46.15, H: 3.85, N: 19.09, S: 8.60.

Part B: Using the procedure for Example 2, the product of Part A was alkylated to afford the title compound as a pale yellow oil. Elemental analysis for
 5 C₁₆H₁₈BrN₅S: Theory C: 48.98, H: 4.62, N: 17.85.
 Found: C: 49.23, H: 4.71, N: 17.72.

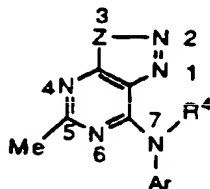
The compounds of Examples 219 and 220 can be made by the method of Example 218.

10

Table 3

[1,2,3]-Thiadiazolo[5,4-d]pyrimidines:

15



20 Ex. No.	Ar	Z	R ⁴
219	2-Br-4-i-Pr-Ph	S	n-C ₃ H ₇
220	2-Br-4-i-Pr-Ph	S	CH ₂ -CH=CH ₂

25

Example 221

N-[2-bromo-4-(1-methylethyl)phenyl]-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

30

Part A: 2,4-Dihydroxy-6-methyl-3-nitropyridine was added to phosphorous oxychloride in a manner similar to Part B of Example 1 to afford 2,4-dichloro-3-nitro-6-methylpyridine as a pale yellow solid (mp 69-70 °C).

Part B: The product of Part A (10.35 g) from above was dissolved in ethanol (100 mL) and then added triethylamine (5.05 g) followed by 3-aminopentane at room temperature under nitrogen atmosphere. The reaction mixture was stirred at room temperature for 4 days, ethanol was removed in vacuum, the residue was partitioned between ethyl acetate (150 mL) and water (150 mL). The organic layer was washed with brine, dried, stripped down to a residue and purified by flash column chromatography to furnish 2-chloro-6-methyl-3-nitro-4-(3-pentyl)aminopyridine as a pale yellow solid (2.8 g; 84-85 °C). Elemental analysis for $C_{11}H_{16}ClN_3O_2$: Theory C: 51.27, H: 6.27, N: 16.30. Found: C: 51.28, H: 6.09, N: 16.07.

Part C: The product of Part B from above was reduced in a manner similar to Part C of Example 1 to afford 3-amino-2-chloro-6-methyl-4-(3-pentyl)aminopyridine as a cream colored solid (mp 165-166 °C). Elemental analysis for $C_{11}H_{18}ClN_3$: Theory C: 58.01, H: 7.98, N: 18.45. Found: C: 57.86, H: 7.83, N: 18.44.

Part D: The product of Part C from above was cyclized in a manner similar to Part E of Example 1 to afford 4-chloro-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo(4,5-c)pyridine as a light pink solid (mp 78-79 °C).

Part E: The product of Part D from above was combined with 2-bromo-4-isopropylaniline in a manner similar to Part C in Example 21, to yield the title compound as a cream colored solid (mp 144-145 °C). Elemental analysis for $C_{20}H_{26}BrN_5$: Theory C: 57.69, H: 6.29, N: 16.82. Found: C: 57.82, H: 6.29, N: 16.90.

Example 222

N-(2-bromo-4,6-dimethoxyphenyl)-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

5

The product of Part D from Example 221 was combined with 2-bromo-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a off-white solid (mp 166-167 °C).

10 Elemental analysis for C₁₉H₂₄BrN₅O₂: Theory C: 52.54, H: 5.58, N: 16.12 Found: C: 52.63, H: 5.53, N: 16.16.

Example 223

15 **N-(2-chloro-4,6-dimethoxyphenyl)-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine**

20 The product of Part D from Example 221 was combined with 2-chloro-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as an off-white solid (mp 168-169 °C).

Example 224

25 **N-(2-bromo-4,6-dimethoxyphenyl)-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine**

30 **Part A:** The product of Part A from Example 221, was treated with 4-aminoheptane in the same manner as outlined in Part B of Example 221 to furnish 2-chloro-4-(4-heptyl)amino-6-methyl-3-nitropyridine as an yellow oil. Elemental analysis for C₁₃H₂₀ClN₃O₂: Theory C: 54.64, H: 7.05, N: 14.70. Found: C: 54.93, 35 H: 7.03, N: 14.62.

Part B: The product of Part A from above was reduced in a manner similar to Part C of Example 1 to afford 3-amino-2-chloro-4-(4-heptyl)amino-6-methylpyridine as a cream colored solid (mp 139-140 °C).

Part C: The product of Part B from above was cyclized in a manner similar to Part E of Example 1 to afford 4-chloro-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridine as an orange yellow solid (mp 90-91 °C).

Part D: The product of Part C from above was combined with 2-bromo-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a brick red colored solid (mp 140-141 °C). Elemental analysis for C₂₁H₂₈BrN₅O₂: Theory C: 54.55, H: 6.10, N: 15.15 Found: C: 54.83, H: 5.95, N: 15.11.

20

Example 225

N-(2-chloro-4,6-dimethoxyphenyl)-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

25

The product of Part C from Example 224 was combined with 2-chloro-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a brick red colored solid (mp 157-158 °C). Elemental analysis for C₂₁H₂₈ClN₅O₂: Theory C: 60.35, H: 6.75, N: 16.76 Found: C: 60.43, H: 6.74, N: 16.99.

30

35

Example 226

(+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-1-(1-ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

5 **Part A:** The product of Part A from Example 221, was treated with 3-aminoheptane in the same manner as outlined in Part B of Example 221 to furnish 2-chloro-4-(3-heptyl)amino-6-methyl-3-nitropyridine as an yellow solid (mp 48-49 °C). Elemental analysis for
10 C₁₃H₂₀ClN₃O₂: Theory C: 54.64, H: 7.05, N: 14.70. Found: C: 54.79, H: 6.95, N: 14.67.

Part B: The product of Part A from above was reduced in a manner similar to Part C of Example 1 to
15 afford 3-amino-2-chloro-4-(3-heptyl)amino-6-methylpyridine as a cream colored solid (mp 139-140 °C).

Part C: The product of Part B from above was
20 cyclized in a manner similar to Part E of Example 1 to afford 4-chloro-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridine as a colored liquid. Elemental analysis for C₁₃H₁₉ClN₄: Theory C: 58.53, H: 7.19, N: 21.00. Found: C: 58.69, H: 7.06, N: 20.76.
25

Part D: The product of Part C from above was combined with 2-bromo-4-isopropylaniline in a manner similar to Part C in Example 21, to yield the title compound as a light pink colored solid (mp 73-74 °C).
30 Elemental analysis for C₂₂H₃₀BrN₅: Theory C: 59.46, H: 6.80, N: 15.76, Found: C: 59.56, H: 6.70, N: 15.70.

35

Example 227

(+/-)-N-(2-bromo-4,6-dimethoxyphenyl)-1-(1-ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

- 5 The product of Part C from Example 226 was combined with 2-bromo-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a brick red colored solid (mp 127-128 °C). Elemental analysis for C₂₁H₂₈BrN₅O₂: Theory C: 54.55, H: 6.10, N: 15.15. Found: C: 54.78, H: 5.84, N: 14.92.

Example 228

- 15 (+/-)-N-(2-chloro-4,6-dimethoxyphenyl)-1-(1-ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

- 20 The product of Part C from Example 226 was combined with 2-chloro-4,6-dimethoxyaniline in a manner similar to Part C in Example 21, to yield the title compound as a brick red colored solid (mp 155-156 °C). Elemental analysis for C₂₁H₂₈ClN₅O₂: Theory C: 60.35, H: 6.75, N: 16.76. Found: C: 60.36, H: 6.65, N: 16.84.

Example 229

- 30 N-[2-bromo-4-(1-methylethyl)phenyl]-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

- 35 Part A: 4-Chloro-6-methyl-3-nitropyridone: 4-Hydroxy-6-methyl-3-nitropyridone (4.0 g, 23.52 mmol) was treated with cyclohexylamine (2.8 mL, 24.46 mmol) in MeOH (50 mL) until all dissolved. The MeOH was stripped in vacuo and the resulting salt was dried and treated with POCl₃ (30 mL) at 25 °C for 30 h. The reaction was then poured into ice/water (400 mL) and extracted with EtOAc

(2x200 mL). The combined EtOAc extracts were washed with water (100 mL), 1 N NaOH (20 mL), water (100 mL) and brine, dried (MgSO₄) and stripped in vacuo. The residue was washed with 20% EtOAc/hexanes (2x30 mL) to give the product (2.9 g).

Part B: 6-Methyl-3-nitro-4-(1-propylbutylamino) pyridone: 4-Chloro-6-methyl-3-nitropyridone (2.9 g, 15.40 mmol) was treated with 1-propylbutylamine (4 mL, 26.8 mmol) in CH₃CN (30 mL) at 25 °C for 64 h and at reflux for 2 h. The reaction mixture was partitioned between EtOAc (200 mL) and water (50 mL). The EtOAc was washed with water (2x50 mL), brine, dried (MgSO₄) and stripped in vacuo. The residue was washed with 20% EtOAc/hexanes (2x20 mL) to give the product (3.7 g).

Part C: 2-Chloro-6-methyl-3-nitro-N-(1-propyl-butyl)pyridin-4-amine: 6-Methyl-3-nitro-4-(1-propylbutylamino) pyridone (3.7 g, 13.84 mmol), was treated with POCl₃ (14 mL) at 25 °C for 20 h. Then it was poured into ice/water (200 mL) and extracted with EtOAc (300 mL). The EtOAc was washed with water, brine, dried (MgSO₄) and stripped in vacuo. The residue was chromatographed on silica gel (20% EtOAc/hexanes eluting solvent) to give the product (3.3 g).

Part D: N-[2-Bromo-4-(1-methylethyl)phenyl]-6-methyl-3-nitro-N-(1-propylbutyl)pyridin-2,4-diamine: 2-Chloro-6-methyl-3-nitro-N-(1-propylbutyl)pyridin-4-amine (0.5 g, 1.75 mmol) and 2-bromo-4-isopropylaniline (0.74 g, 3.5 mmol) were heated at 140 °C for 4.5 h. After cooling it was dissolved in CH₂Cl₂ and filtered through a short column of silica gel. The filtrate was concentrated and chromatographed on silica gel (5%

EtOAc/hexanes eluting solvent) to give the product (0.7 g).

Part E: N-[2-Bromo-4-(1-methylethyl)phenyl]-6-methyl-N-(1-propylbutyl)pyridine-2,3,4-triamine: N-[2-Bromo-4-(1-methylethyl)phenyl]-6-methyl-3-nitro-N-(1-propylbutyl)pyridin-2,4-diamine (0.7 g, 1.51 mmol), was suspended between dioxane (30 mL) and water (30 mL) containing conc.NH₄OH (1.2 mL). To that Na₂S₂O₄ was added (2.1 g, 12.06 mmol) and the mixture was stirred at 25 °C for 2h. Then an additional 1g Na₂S₂O₄ was added followed by 10 mL dioxane and 10 mL water. After stirring for 1 h at 25 °C the mixture was partitioned between EtOAc (120 mL) and water (20 mL). The EtOAc was washed with water (100 mL), brine, dried (MgSO₄) and stripped in vacuo. The residue was chromatographed on silica gel (20% EtOAc/hexanes eluting solvent) to give the product (0.5 g).

20

Part F: N-[2-bromo-4-(1-methylethyl)phenyl]-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine: N-[2-Bromo-4-(1-methylethyl)phenyl]-6-methyl-N-(1-propylbutyl) pyridine-2,3,4-triamine (0.5 g, 1.15 mmol), dissolved in CH₂Cl₂ (6 mL) and 50% AcOH (4 mL) was treated with NaNO₂ (0.0846 g, 1.22 mmol) at 25 °C for 16 h. The mixture was partitioned between EtOAc (100 mL) and water (20 mL) The EtOAc was washed with water (20 mL), brine, dried and stripped in vacuo. The residue was chromatographed on silica gel (20% EtOAc/hexanes eluting solvent) to give the product (0.2 g). Anal. Calcd. for C₂₂H₃₀BrN₅: C, 59.46; H, 6.80; N, 15.76; Br, 17.98. Found: C, 59.76; H, 6.83; N, 15.67; Br, 18.17.

35

Example 231

***N*-[4-(1-methylethyl)-2-sulfonylmethylphenyl]-6-methyl-1-(1-propylbutyl)-1*H*-1,2,3-triazolo[4,5-*c*]pyridin-4-amine**

5 *N*-[4-(1-methylethyl)-2-thiomethylphenyl]-6-methyl-1-(1-propylbutyl)-1*H*-1,2,3-triazolo[4,5-*c*]pyridin-4-amine (0.15 g, 1 equiv.) (Example 231), synthesized under the same general conditions of Example 229, was dissolved in methanol (3 mL) and
10 water (2 mL) was added, followed by NaIO₄ (0.114 g, 1.5 equiv.). The mixture was stirred at 25 °C for 20 h and then was extracted with EtOAc (80 mL). The EtOAc was washed with water, brine, dried and stripped in vacuo. The residue was dissolved in CH₂Cl₂ and a
15 solution of KMnO₄ (0.15 g, 2.5 equiv.) in water (2 mL) was added, followed by benzyltriethylammonium chloride (0.15 g, 1.5 equiv.). The mixture was stirred at 25 °C for 20 h and then extracted with EtOAc (80 mL) and the EtOAc was washed with water, brine, dried and stripped
20 in vacuo. The residue was chromatographed on silica gel (10% EtOAc/hexanes eluting solvent) to give the product (0.2 g). Anal. Calcd. for C₂₃H₃₃BrN₅O₂S: C, 62.27; H, 7.51; N, 15.79; S, 7.24. Found: C, 62.62; H, 7.38; N, 15.58 S, 7.44.

25

Example 232

***N*-[4-(4-acetyl-2-bromophenyl)-6-methyl-1-(1-propyl-butyl)-1*H*-1,2,3-triazolo[4,5-*c*]pyridin-4-amine**

30

PART A: Used the standard procedure for the coupling of the nitropyridine (0.8 g, 2.9 mmols) and 2-Bromo-4-iodoaniline (1.7 g, 5.7 mmols). Preabsorbed the crude material on 12 g. of silica gel
35 before chromatographing on silica gel (5% EtOAc/hexane eluent) to give an orange solid, 1.47 g. of the desired product.

PART B: To the coupled 2-Bromo-4-iodoanilinonitropyridine (0.60 g, 1.1 mmol) in a dried flask, under nitrogen, was added

5 Bis(triphenylphosphine)palladium(II)chloride (18 mg, 0.026 mmol) and anhydrous toluene (5 mL). Added 1-Ethoxyvinyltributyltin (0.46 mL, 1.36 mmol) and stirred at reflux temperature for 1 1/2 hours. Dissolved into ethyl acetate then filtered off the

10 insolubles through celite. Washed the solids 2 x with ethyl acetate. Concentrated in-vacuo the filtrates to near dryness. Stirred the residue with 70 mL 1M hydrochloric acid for 1/2 hour. Added some ethyl acetate and separated the layers., extracted the

15 water layer with 2 x 20 mL ethyl acetate. Concentrated the combined organics to near dryness. Stirred the residue in a saturated potassium fluoride (20 mL) for 1/2 hour. Separated the layers. Extracted the water layer with 2 x 20 mL ethyl acetate. Washed

20 the combined extracts with 10 mL water and 20 mL brine. Chromatographed the crude material on silica gel to give a solid, 0.37 g (73 %) of the desired product.

25 **PART C:** Using the product obtained from Part B (0.70 g, 1.5 mmol), 10 mL tetrahydrofuran, 10 mL water, 0.70 mL ammonium hydroxide solution (38-40%) and sodium dithionite (2.1 g, 12 mmol) followed the standard procedure to reduce the nitroanilinopyridine.

30 Obtained the crude solid, 0.65 g, which was of sufficient purity for further reaction.

PART D: Followed the standard procedure to cyclize the product obtained in Part C (0.63 g, 1.45

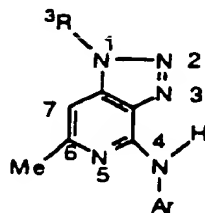
35 mmol), using 10 mL methylene chloride, 10 mL acetic acid/water (50%), and sodium nitrite (0.18 g, 2.59 mmol) in 1 mL water. Chromatographed on silica gel

(10% ethyl acetate / hexane) to give a white solid, 0.31 g, (48%) of desired product, mp 165-166 °C. Anal. Calcd. for C₂₁H₂₆BrN₅O: C, 56.76; H, 5.91; N, 15.76; Br, 17.98. Found: C, 56.75; H, 5.76; N, 15.71; Br, 17.72. Obtained the isomer of the desired product, a white solid, 90 mg, mp 133-136 °C. Anal. Calcd: Found: C, 57.11; H, 5.82; N, 15.69; Br, 18.23.

The rest of the examples shown in Table 4 were prepared by following the general procedure outlined in Example 229.

Table 4

1H-1,2,3-triazolo[4,5-c]pyridines:



Ex. No.	R ³	Ar	Mp °C
233	CH(Et)CH ₂ -OCH ₃	2-Br-4-i-Pr-Ph	121-123
234	CH(Et)CH ₂ -OCH ₃	4-i-Pr-2-SMe-Ph	97-100
235	CH(i-C ₃ H ₇) ₂	2-Br-4-(i-C ₃ H ₇)Ph	96-96
236	CH(i-C ₃ H ₇) ₂	4-(i-C ₃ H ₇)-2-SMe-Ph	
237	CH(C ₂ H ₅) ₂	4-(i-C ₃ H ₇)-2-SMe-Ph	
238	CH(n-C ₃ H ₇) ₂	2-Br-4-I-Ph	161-164
239	CH(n-C ₃ H ₇) ₂	2,4-(Br) ₂ -Ph	125-127
240	CH(Et)CH ₂ -OCH ₃	2,4,6-Me ₃ -Ph	
241	i-Pr	2-Br-4-i-Pr-Ph	
242	i-Pr	4-i-Pr-2-SMe-Ph	
243	c-Pr	2-Br-4-i-Pr-Ph	

	244	c-Pr	4-i-Pr-2-SMe-Ph
	245	i-Pr	2,4-(Br) ₂ -Ph
	246	c-Pr	2,4-(Br) ₂ -Ph
	247	CH(Et)CH ₂ -OCH ₃	2,4-(Br) ₂ -Ph
5	248	CH(Et) ₂	2,4-(Br) ₂ -Ph
	249	CH(Et)CH ₂ -OCH ₃	2-COMe-4-Br-Ph
	250	CH(Et) ₂	4-COMe-2-Br-Ph
	251	CH(Et) ₂	2-Br-4-SO ₂ Me-Ph
	252	CH(Et) ₂	2,4,6-Me ₃ -Ph
10	253	CH(CH ₂ CN) ₂	2-Br-4-(i-C ₃ H ₇)Ph
	254	CH(Et)CH ₂ CN	2-Br-4-(i-C ₃ H ₇)Ph
	255	CH(Et)CH ₂ CONMe ₂	2-Br-4-(i-C ₃ H ₇)Ph
	256	CH(CH ₂ CN) ₂	2-Br-4,6-(OMe) ₂ Ph
	257	CH(Et)CH ₂ CN	2-Br-4,6-(OMe) ₂ Ph
15	258	CH(Et)CH ₂ CONMe ₂	2-Br-4,6-(OMe) ₂ Ph

Example 259

20 **N-(2-chloro-4,6-dimethylphenyl)-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine:**

Part A: Serinol (24 g) was added to a solution of trityl chloride (65 g) and triethylamine (51.0 g) in 600 mL of dry DMF. After stirring at room temperature for 48 h, the reaction was poured into water and extracted several times with diethyl ether. The combined organic layers were dried over anhydrous magnesium sulfate and concentrated to dryness to afford N-triphenylmethylserinol (71.0 g).

Part B: Methyl iodide (90 mL) was added to a suspension of N-triphenylmethylserinol (37.0 g) and powdered sodium hydroxide (45.0 g) in 400 mL of dry DMSO. After stirring at room temperature for 24-36 h, the reaction was added to water (800 mL) and extracted with diethyl ether (3 X 500 mL). The combined organic layers was washed with water (4 X 250 mL),

dried over anhydrous magnesium sulfate and concentrated to afford 1,3-dimethoxy-2-triphenylmethylaminopropane (36.0 g) as a thick viscous oil.

5

Part C: To a solution of the product of Part B (36.0 g) in methanol (400 mL) was added 1 M HCl in ether (350 mL). After stirring overnight, the reaction was poured over water (800 mL) extracted with
10 hexane (3 X 250 mL). The methanol/water layer was concentrated to dryness to afford 1,3-dimethoxy-2-aminopropane hydrochloride (14.0 g) as a waxy solid.

Part D: 4-Chloro-6-methyl-3-nitro-2-pyridone: 4-Hydroxy-6-methyl-3-nitro-2-pyridone
15 (50.0 g) was treated with cyclohexylamine (40 g) in MeOH (300 mL) and heated until all dissolved. The MeOH was stripped in vacuum and the resulting salt was dried and treated with POCl₃ (360 mL) at 25 °C for 48 h. The excess POCl₃ was removed under vacuum and the
20 residue was poured into ice/water (1000 mL) and extracted with EtOAc (4x250 mL). The combined EtOAc extracts were washed with aq. NaHCO₃, brine (3 *100 mL), dried (MgSO₄) and stripped in vacuum. The residue was washed with 20% EtOAc/hexanes (2x100 mL) to afford
25 the product as a yellow solid (41.3 g; mp 225 °C).

Part E: 4-[1-methoxymethyl-(2-methoxyethyl)amino-6-methyl-3-nitro-2-pyridone:
4-Chloro-6-methyl-3-nitro-2-pyridone (12.12 g; from
30 part D) was treated with 1,3-dimethoxy-2-aminopropane hydrochloride (10.0 g; from part C) in CH₃CN (200 mL) and diisopropylethylamine (20.0 g) at 25 °C for 24 h and at reflux for 3 h. The reaction mixture was partitioned between EtOAc (200 mL) and water (50 mL).
35 The EtOAc was washed with water (2x50 mL), brine, dried (MgSO₄) and stripped in vacuum to give the product as a yellow solid (9.4 g; m.p. 172-173 °C).

Part. P: 2-Chloro-N-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-3-nitro-pyridin-4-amine: 4-[1-methoxymethyl-(2-methoxyethyl)amino-6-methyl-3-nitro-2-pyridone (9.4 g from part E), was treated with POCl_3 (55 mL) at 25 °C for 24 h. The excess POCl_3 was removed under vacuum, and the residue was poured into ice/water (200 mL) and extracted with CH_2Cl_2 (3 X 150 mL). The combined CH_2Cl_2 extract was washed with water, dried (MgSO_4) and stripped in vacuum to give the product as a yellow solid (9.0 g; m.p. 85-87 °C).

Part G: 2-Chloro-4-[1-methoxymethyl-(2-methoxyethyl)amino-6-methylpyridin-3-amine: The product of Part F (9.0 g) was added to acetic acid (80 mL) and methanol (400 mL). To this mixture was added iron powder (9.0 g) in portions, stirred for 5 h at 60-65 °C, cooled to room temperature, and filtered through celite. The filtrate was stripped to a brown solid, which was extracted with ethyl acetate (2 x 150 mL), washed with NaHCO_3 (100 mL), and brine (100 mL). The organic layer was dried over anhydrous magnesium sulfate, filtered and stripped down to yield the product as a pale yellow solid (5.6 g; m.p. 100 °C).

Part H: 4-Chloro-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridine: The product of Part G (5.4 g) was dissolved in dichloromethane (100 mL) and 50 % aqueous acetic acid (100 mL). To this stirred mixture was added sodium nitrite (1.7 g) in water (10 mL) dropwise at room temperature. After completion of addition, the reaction was stirred for an additional 15 mins. The organic layer was separated, washed with water, dried with anhydrous magnesium sulfate, and stripped

down to a residue. The residue was purified by flash column chromatography (CH_2Cl_2) to afford the product as a pale yellow solid (5.4 g; m.p. 49-50 °C).

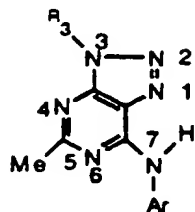
- 5 **Part I: *N*-(2-chloro-4,6-dimethylphenyl)-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1*H*-1,2,3-triazolo[4,5-*c*]pyridin-4-amine:** The product of Part H (2.0 g) from above was combined with 2-chloro-4,6-dimethylaniline (1.4 g) in the presence
10 of *p*-toluenesulfonic acid (1.7 g) in toluene (25.0 mL) at 110 °C for 4h. The reaction mixture was partitioned between EtOAc (50 mL) and aq. NaHCO_3 (50 mL), washed the organic layer with brine, dried and stripped in vacuum to a residue. The residue was purified by
15 flash column chromatography (1:100::MeOH: CH_2Cl_2) to afford the title compound as white solid (1.7 g; mp 83-84 °C) after crystallization from ether/pentane. Elemental analysis for $\text{C}_{19}\text{H}_{24}\text{ClN}_5\text{O}_2$: Theory C: 58.53, H: 5.20, N: 17.96, Cl: 9.09. Found: C: 58.69, H: 6.32, N: 17.97, Cl: 9.18.

- Part J: Mesylate salt of *N*-(2-chloro-4,6-dimethylphenyl)-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1*H*-1,2,3-triazolo[4,5-*c*]pyridin-4-amine:** The product of Part I (850 mg)
25 was dissolved in dichloromethane (5.0 mL) and then added methanesulfonic acid (250 mg). The solvent was removed and the residue was crystallized from 2-propanol (2.5 mL) to afford the mesylate salt (920 mg;
30 m.p. 179-180 °C) as a white crystalline solid. Elemental analysis for $\text{C}_{20}\text{H}_{28}\text{ClN}_5\text{O}_5\text{S}$: Theory C: 49.43, H: 5.82, N: 14.41. Found: C: 49.42, H: 5.79, N: 14.37.

35

The compounds listed in Tables 5 and 6 were prepared by the methods exemplified in Examples 1-53 and 526.

Table 5
3H-1,2,3-triazolo[4,5-d]pyrimidines:



5

Ex. No.	Ar	R ³	m.p. (°C)	
10	260	2-Br-2,6-(Me) ₂ -Ph	CH(Et) ₂	134-135
	261	2-Cl-2,6-(Me) ₂ -Ph	CH(Et) ₂	133-134
	262	4-Br-2-Cl-6-Me-Ph	CH(Et) ₂	132-133
	263	2,4-(Cl) ₂ -6-Me-Ph	CH(Et) ₂	132-133
	264	2,4-(Br) ₂ -6-F-Ph	CH(Et) ₂	186-188
15	265	4-Br-2-Me-Ph	CH(Et) ₂	125-127
	266	4-NMe ₂ -2-Me-Ph	CH(Et) ₂	136-137
	267	4-Cl-2-Me-Ph	CH(Et) ₂	116-118
	268	4-I-2-Me-Ph	CH(Et) ₂	139-140
	269	4-NMe ₂ -2,6-(Me) ₂ -Ph	CH(Et) ₂	160-161
20	270	2-Cl-4-Me-Ph	CH(Et) ₂	100-101
	271	2-Br-4-OMe-Ph	CH(Et) ₂	146-147
	272	2-Br-4-NMe ₂ -Ph	CH(Et) ₂	166-167
	273	2-Me-4-CH ₂ OMe-Ph	CH(Et) ₂	oil
	274	2-CN-4-Me-Ph	CH(Et) ₂	221-223
25	275	4-CN-2-Me-Ph	CH(Et) ₂	216-218
	276	2,4,6-Me ₃ -Ph	CH(nPr)Me	140.5-142
	277	4-Br-2,6-Me ₂ -Ph	CH(nPr)Me	131-133
	278	2-Cl-4,6-Me ₂ -Ph	CH(nPr)Me	amorph.
	279	2-Cl-4,6-(OMe) ₂ -Ph	CH(nPr)Me	144-145
30	280	2,4,5-Me ₃ -Ph	CH(nPr)Me	110-112
	281	4-Cl-2-Me-Ph	CH(nPr)Me	99-101
	282	4-Br-2-Me-Ph	CH(nPr)Me	83-84.5
	283	4-I-2-Me-Ph	CH(nPr)Me	104-105
	284	2,4-Me ₂ -Ph	CH(nPr)Me	74.5-76.5

	285	2-Br-4-CH(Me) ₂ -Ph	CH(nPr)Me	amorph.
	286	2-Br-4-Cl-Ph	CH(nPr)Me	104-108
	287	2-Br-4-NMe ₂ -Ph	CH(nPr)Me	Amorph.
	288	4-NMe ₂ -2-Me-Ph	CH(nPr)Me	amorph.
5	289	2,4-(Me) ₂ -Ph	CH(Et)n-Pr	88-89
	290	4-OMe-2-Me-Ph	CH(Et)n-Pr	111-112
	291	2,4-(SMe) ₂ -Ph	CH(Et)n-Pr	65-66
	292	2-Br-4-CF ₃ -Ph	CH(Et)n-Pr	91-92
	293	4-Ac-2-Br-Ph	CH(Et)n-Pr	138-139
10	294	4-NMe ₂ -2-Me-Ph	CH(Et)n-Pr	116.5-118
	295	4-Cl-2-Me-Ph	CH(Et)n-Pr	amorph.
	296	4-I-2-Me-Ph	CH(Et)n-Pr	110-111.5
	297	2,6-Me ₂ -4-I-Ph	CH(Et)n-Pr	158-160
	298	4-Ac-2-Me-Ph	CH(Et)n-Pr	107-110.5
15	299	2-NMe ₂ -4-Me-Ph	CH(Et)n-Pr	106-107
	300	4-NMe ₂ -2,6-(Me) ₂ -Ph	CH(Et)n-Pr	146-148
	301	2,4-(SMe) ₂ -Ph	CH(n-Pr) ₂	105-106
	302	4-OMe-2-Me-Ph	CH(n-Pr) ₂	109-110
	303	2-Br-4-N(Me) ₂ -Ph	CH(n-Pr) ₂	102-103
20	304	2,4-(Me) ₂ -Ph	CH(n-Pr) ₂	97-98
	305	4-Ac-2,6-(Me) ₂ -Ph	CH(n-Pr) ₂	162-164
	306	4-Cl-2-Me-Ph	CH(n-Pr) ₂	126-127.5
	307	4-NMe ₂ -2-Me-Ph	CH(n-Pr) ₂	129-130.5
	308	4-I-2-Me-Ph	CH(n-Pr) ₂	98.5-101
25	309	2-Me-4-CH ₂ OMe-Ph	CH(n-Pr) ₂	oil
	310	4-Br-2,6-Me ₂ -Ph	CH(Et)CH ₂ OMe	140-141
	311	4-Br-2,6-Me ₂ -Ph	CH(Et)CH ₂ OMe	139-140
	312	2-Cl-4,6-(Me) ₂ -Ph	CH(Et)CH ₂ OMe	141-142
	313	4-Br-2-Cl-6-Me-Ph	CH(Et)CH ₂ OMe	121-122
30	314	2,4-(Cl) ₂ -6-Me-Ph	CH(Et)CH ₂ OMe	109-110
	315	2,4-(Br) ₂ -6-F-Ph	CH(Et)CH ₂ OMe	147-148
	316	2-Br-3,4,6-(Me) ₃ -Ph	CH(Et)CH ₂ OMe	166-167
	317	3-Br-2,4,6-(Me) ₃ -Ph	CH(Et)CH ₂ OMe	147-148
	318	4-Br-2,6-(F) ₂ -Ph	CH(Et)CH ₂ OMe	148-149
35	319	2-Br-4-Cl-6-F-Ph	CH(Et)CH ₂ OMe	139-140
	320	2-Br-4,6-(F) ₂ -Ph	CH(Et)CH ₂ OMe	124-125
	321	4-CN-2,6-(Cl) ₂ -Ph	CH(Et)CH ₂ OMe	180-181

	322	2,4-(SMe) ₂ -Ph	CH(Et)CH ₂ OMe	75-77
	323	2-Br-4-N(Me) ₂ -Ph	CH(Et)CH ₂ OMe	110-112
	324	2-Cl-4-CN-6-Me-Ph	CH(Et)CH ₂ OMe	145-146
	325	2-Cl-4-CN-Ph	CH(Et)CH ₂ OMe	140
5	326	2,4,5-(Me) ₃ -Ph	CH(Et)CH ₂ OMe	108-109
	327	2,4-(Me) ₂ -Ph	CH(Et)CH ₂ OMe	104-105
	328	4-Br-2,6-(Et) ₂ -Ph	CH(Et)CH ₂ OMe	151-152
	329	4-Br-2,6-(Cl) ₂ -Ph	CH(Et)CH ₂ OMe	109-110
	330	2-Br-4,6-(Cl) ₂ -Ph	CH(Et)CH ₂ OMe	113-114
10	331	2,6-(Br) ₂ -4-Cl-Ph	CH(Et)CH ₂ OMe	153-154
	332	4-Br-2-Me-6-NO ₂ -Ph	CH(Et)CH ₂ OMe	150-151
	333	4-OMe-2-Me-Ph	CH(Et)CH ₂ OMe	128-129
	334	2,5-Cl ₂ -4-NMe ₂ -Ph	CH(Et)CH ₂ OMe	84-85
	335	2,4-Cl ₂ -Ph	CH(Et)CH ₂ OMe	114-116
15	336	2-Br-4-Cl-Ph	CH(Et)CH ₂ OMe	133.5-135
	337	4-Cl-2-Me-Ph	CH(Et)CH ₂ OMe	amorph.
	338	4-I-2,6-Me ₂ -Ph	CH(Et)CH ₂ OMe	148.5-150
	339	4-NMe ₂ -2,6-(Me) ₂ -Ph	CH(Et)CH ₂ OMe	144-146
	340	2-Cl-4-Me-Ph	CH(Et)CH ₂ OMe	88-89
20	341	2-Br-4-OMe-Ph	CH(Et)CH ₂ OMe	118-120
	342	2-Me-4-CH ₂ OMe-Ph	CH(Et)CH ₂ OMe	oil
	343	2,4,6-Me ₃ -Ph	CH(Et)CH ₂ OEt	127-130
	344	2-Cl-4,6-Me ₂ -Ph	CH(Et)CH ₂ OEt	61-62
	345	4-Br-2,6-Me ₂ -Ph	CH(Et)CH ₂ OEt	104-107
25	346	2,4-Me ₂ -Ph	CH(Et)CH ₂ OEt	oil
	347	2-Br-4-Me-Ph	CH(Et)CH ₂ OEt	100-102
	348	2,4,6-Me ₃ -Ph	CH(Et)CH ₂ OEt	94-96.5
	349	2,4,6-Me ₃ -Ph	CH(C ₃ H ₇)CH ₂ OMe	136-138
	350	2-Cl-4,6-Me ₂ -Ph	CH(C ₃ H ₇)CH ₂ OMe	amorph.
30	351	4-Br-2,6-Me ₂ -Ph	CH(C ₃ H ₇)CH ₂ OMe	139-140.5
	352	2,4-Me ₂ -Ph	CH(C ₃ H ₇)CH ₂ OMe	oil
	353	2-Br-4-Me-Ph	CH(C ₃ H ₇)CH ₂ OMe	100.5-102
	354	2,4,5-Me ₃ -Ph	CH(C ₃ H ₇)CH ₂ OMe	122-124
	355	2,4,6-Me ₃ -Ph	CH(CHMe ₂)CH ₂ OMe	94-96.5
35	356	2-Cl-4,6-Me ₂ -Ph	CH(CHMe ₂)CH ₂ OMe	155-156
	357	4-Br-2,6-Me ₂ -Ph	CH(CHMe ₂)CH ₂ OMe	156-159
	358	2,4-Me ₂ -Ph	CH(CHMe ₂)CH ₂ OMe	99-103

	359	2-Br-4-Me-Ph	CH(CHMe ₂)CH ₂ OMe	93-95
	360	2,4,5-Me ₃ -Ph	CH(CHMe ₂)CH ₂ OMe	130-131
	361	2,4,6-Me ₃ -Ph	CH(sec-Bu)CH ₂ OMe	168-170.5
	362	2-Cl-4,6-Me ₂ -Ph	CH(sec-Bu)CH ₂ OMe	136-139
5	363	4-Br-2,6-Me ₂ -Ph	CH(sec-Bu)CH ₂ OMe	139-142
	364	2,4-Me ₂ -Ph	CH(sec-Bu)CH ₂ OMe	85-87
	365	2-Br-4-Me-Ph	CH(sec-Bu)CH ₂ OMe	78.5-80
	366	2,4,5-Me ₃ -Ph	CH(sec-Bu)CH ₂ OMe	150-153
	367	2,4,6-Me ₃ -Ph	CH(isoBu)CH ₂ OMe	126.6-129
10	368	2-Cl-4,6-Me ₂ -Ph	CH(isoBu)CH ₂ OMe	103-10
	369	4-Br-2,6-Me ₂ -Ph	CH(isoBu)CH ₂ OMe	127.5-130
	370	2,4-Me ₂ -Ph	CH(isoBu)CH ₂ OMe	amorph.
	371	2-Br-4-Me-Ph	CH(isoBu)CH ₂ OMe	99-100.5
	372	2,4,5-Me ₃ -Ph	CH(isoBu)CH ₂ OMe	134-138
15	373	2-Cl-4,6-Me ₂ -Ph	CH(CH ₂ OMe) ₂	98-99
	374	4-Br-2,6-Me ₂ -Ph	CH(CH ₂ OMe) ₂	115-116
	375	4-OMe-2-Ph-Ph	CH(CH ₂ OMe) ₂	55-57
	376	3-Br-2,4,6-Me ₃ -Ph	CH(CH ₂ OMe) ₂	151-152
	377	4-Br-2,6-Et ₂ -Ph	CH(CH ₂ OMe) ₂	154-155
20	378	2,4,6-(Me) ₃ -Ph	CH(CH ₂ OMe) ₂	136-137
	379	4-Br-2-Me-Ph	CH(CH ₂ OMe) ₂	104-108
	380	2-Br-4-Cl-Ph	CH(CH ₂ OMe) ₂	123-125
	381	2,4-Cl ₂ -Ph	CH(CH ₂ OMe) ₂	87.5-90
	382	4-NMe ₂ -2-Me-Ph	CH(CH ₂ OMe) ₂	159-162
25	383	4-Cl-2-Me-Ph	CH(CH ₂ OMe) ₂	100-102
	384	4-I-2-Me-Ph	CH(CH ₂ OMe) ₂	116-117.5
	385	2,6-Me ₂ -4-I-Ph	CH(CH ₂ OMe) ₂	amorph.
	386	2-NMe ₂ -4-Me-Ph	CH(CH ₂ OMe) ₂	100-102
	387	2-Br-4-Me-Ph	CH(CH ₂ OMe) ₂	106-108
30	388	2-Cl-4-Me-Ph	CH(CH ₂ OMe) ₂	114-115
	389	4-NMe ₂ -2,6-(Me) ₂ -Ph	CH(CH ₂ OMe) ₂	71-73
	390	2-Br-4-OMe-Ph	CH(CH ₂ OMe) ₂	127-128
	391	2-Br-4-NMe ₂ -Ph	CH(CH ₂ OMe) ₂	139-141
	392	2-Me-4-CH ₂ OMe-Ph	CH(CH ₂ OMe) ₂	oil
35	393	2,4,6-Me ₃ -Ph	CH(Et)CH ₂ Ph	amorph.
	394	2,4,6-Me ₃ -Ph	2-OMe-6-Me-Ph	202-205
	395	2,4,6-Me ₃ -Ph	CH(Et)CH ₂ OH	amorph.

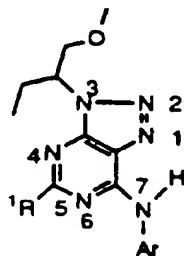
396	2,4,6-Me ₃ -Ph	CH(Me)isoBu	126-127
397	2,4,6-Me ₃ -Ph	CH(Me)isoPr	161-162
398	2,4,6-Me ₃ -Ph	cyclopentyl	174-175
399	2,4,6-Me ₃ -Ph	cyclohexyl	198-199
5 400	2,4,6-Me ₃ -Ph	4-methylcyclohexyl	178-180

Note: (+), (-), (R) or (S) denotes respective isomers

10

Table 6

3H-1,2,3-triazolo[4,5-d]pyrimidines:



15	Ex. No.	Ar	R ¹	m.p. (°C)
	401	2,4,6-Me ₃ -Ph	H	146-147
	402	4-Br-2,6-Me ₂ -Ph	H	139-140
	403	2,4,6-Me ₃ -Ph	CF ₃	176-177
20	404	4-Br-2,6-Me ₂ -Ph	CF ₃	183-184
	405	2-Cl-4,6-Me ₂ -Ph	CF ₃	174-175
	406	2,4-Cl ₂ -6-Me-Ph	CF ₃	160-161
	407	2-Cl-4,6-Me ₂ -Ph	C ₂ H ₅	111-112
	408	2-Cl-4,6-Me ₂ -Ph	MeOCH ₂	87-88
25				

Example 409

6-[N-(2-chloro-4,6-dimethylphenyl)]-9-[(1-methoxymethyl)propyl]-2-methyl-9H-purin-6,8-diamine:

30 **Part A:** 2-methyl-4-chloro-5-(1-methoxymethyl)propylamino-5-aminopyridine (450 mg, 1.84 mmol) was

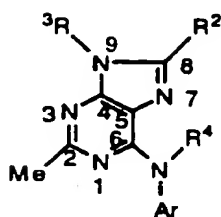
reacted with cyanogen bromide (234 mg, 2.2 mmol) in refluxing methanol for 24 h. The solvent was removed in vacuo and the resulting crude oil was taken up in ethyl acetate and washed 3 times with saturated aqueous
5 NaHCO₃. The organic layer was dried then stripped in vacuo and the crude product was chromatographed on silica gel (20 g, ethyl acetate neat) providing 240 mg (48%) of 8-amino-6-chloro-9-[(1-methoxymethyl)propyl]-2-methyl-9H-purine.

10

Part B: The product from part B (50 mg, 0.20 mmol) was treated with 2-chloro-4,6-dimethylaniline (30 mg, 0.20 mmol) in refluxing 1.0 N HCl for 24 h. The reaction was cooled then poured into saturated aqueous
15 NaHCO₃ and extracted (3 times 50 ml) with ethyl acetate. The organic fractions were combine, dried and stripped in vacuo. The resulting crude product was chromatographed on silica gel (20 g, ethyl acetate neat) providing 55 mg (71%) of the title compound.
20 Anal. Calcd. for C₁₉H₂₅N₆OCl: C, 58.76; H, 6.44; N, 21.65. Found: C, 58.50; H, 6.32; N, 21.72.

The compounds of Table 7 can be made by the methods
25 exemplified in Examples 209-211 and 409.

Table 7
9H-imidazo[4,5-d]pyrimidines:



5

Ex.	No.	Ar	R ²	R ³	m.p. (°C)
	410	2,4,6-(Me) ₃ -Ph	H	CH(Et)CH ₂ OCH ₃	212-213
10	411	2,4,6-(Me) ₃ -Ph	NH ₂	CH(Et)CH ₂ OCH ₃	oil
	412	2-Cl-4,6-(Me) ₂ -Ph	NH ₂	CH(CH ₂ OCH ₃) ₂	oil
	413	2,4,6-(Me) ₃ -Ph	NH ₂	CH(CH ₂ OCH ₃) ₂	oil

15

Example 414

(S)-(-)-N-(2-chloro-4,6-dimethylphenyl)-6-methyl-1-(1-methoxymethyl-3-methoxypropyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

20

Part A: L-Dimethyl aspartate hydrochloride (5 g, 25.3 mmol) and triphenylmethyl chloride (7.65 g, 27.5 mmol) were suspended in dry CH₃CN (50 mL) at 0 °C. To that Et₃N (4.5 mL, 32.3 mmol) was added dropwise, followed by N-methylmorpholine (2.5 mL, 27.5 mmol). The mixture was stirred at 0 °C for 1 h and at 25 °C for 30 min. Then it was partitioned between EtOAc (200 mL) and water (50 mL) and the organic extract was washed with water (50 mL), brine (50 mL), dried (MgSO₄) and stripped in vacuo. The product, diethyl N-triphenylmethyl aspartate, was >90% clean by NMR analysis.

30

NMR(CDCl₃) δ 7.16-7.51 (m, 15 H), 3.68 (s, 3H), 3.66-3.74 (m, 1H), 3.26 (s, 3H), 2.93 (d, 1H, J=9.9Hz), 2.63-2.69 (dd, 1H, J₁=14.6, J₂=5.1 Hz), 2.48-2.55 (dd, 1H, J₁=14.6 Hz, J₂=7 Hz).

5

Part B: (S)-Diethyl N-triphenylmethyl aspartate (~25 mmol) was dissolved in dry THF (150 mL) and cooled to 0 °C. To that a 1 M solution of LiAlH₄ in THF (50 mL, 50 mmol) was added dropwise and the reaction was stirred for 2 h and allowed to warm to 25 °C. Then it was cooled and quenched with water (5 mL) and 1 N NaOH (4 mL), diluted with ether (200 mL) and the precipitated solids were filtered off. The filtrate was concentrated in vacuo to give the product, 2-N-triphenylamino-1,4-butane diol (>90% clean by NMR analysis).
NMR(CDCl₃) δ 7.17-7.57 (m, 15H), 3.68-3.77 (m, 1H), 3.56-3.63 (m, 1H), 3.19 (d, 1H, J=8.8 Hz), 2.76-2.86 (m, 2H), 2.2-2.7 (br, 3H), 1.54-1.63 (m, 1H), 1.36-1.54 (m, 1H).

20

Part C: (S)-2-N-triphenylamino-1,4-butane diol (~25 mmol) dissolved in dry THF (50 mL) was added into a suspension of NaH 60% in oil (2.34 g, 58.5 mmol) in dry THF (50 mL) at 0 °C, and the mixture was stirred at 9 °C for 30 min and at 25 °C for 1 h. Then it was cooled in an ice bath and CH₃I (3.6 mL, 58.5 mmol) was added dropwise. The reaction was stirred at 0 °C for 30 min and at 25 °C for 2 h, the excess NaH was quenched with water and the THF was stripped off. The residue was partitioned between EtOAc (200 mL) and water (50 mL) and the organic extract was washed with water (50 mL), brine (50 mL), dried (MgSO₄) and stripped in vacuo. The product, 2-N-triphenylamino-1,4-dimethoxy butane was >90% clean by NMR analysis.
NMR(CDCl₃) δ 7.15-7.59 (m, 15 H), 3.34-3.41 (m, 1H), 3.22-3.30 (m, 1H), 3.24 (s, 3H), 3.03 (s, 3H), 2.86 (dd, 1H, J₁=9.5 Hz, J₂=3.3 Hz), 2.65-2.75 (m, 1H), 2.4-2.46 (br, 1H), 2.30-2.35 (m, 1H), 2.57-2.8 (m, 2H).

35

Part D: (S)-2-N-Triphenylamino-1,4-dimethoxy
butane (~25 mmol) was dissolved in a mixture of CH₂Cl₂
(100 mL) and methanol (50 mL) and 1 M HCl in ether was
5 added (50 mL). The reaction was stirred at 25 °C for 16
h, the solvent was stripped off and the residue was
washed with 1:1 ether/hexane (3x50 mL). The remaining
oil, 2-amino-1,4-dimethoxybutane hydrochloride, was
dried under vacuum (3.87 g, 88%).
10 NMR(CDCl₃) δ 8.2-8.5 (br, 3H), 3.5-3.7 (m, 5H), 3.41 (s,
3H), 3.36 (s, 3H), 2.05-2.2 (m, 1H), 1.90-2.01 (m, 1H).

Part E: (S)-6-Methyl-3-nitro-4-(1-
methoxymethyl-3-methoxypropylamino) pyridone: 1-
15 methoxymethyl-3-methoxypropylamine (4.19 g, 22.3 mmol),
and 4-chloro-6-methyl-3-nitropyridone (3.87 g, 22.3
mmol) were mixed in CH₃CN (70 mL) and diisopropyl-
ethylamine (9.4 mL, 53.6 mmol) was added. The reaction
was stirred at 25 °C for 16 h and at reflux for 2.5 h.
20 The solvent was stripped off and the residue was
dissolved in CH₂Cl₂ (150 mL) and the CH₂Cl₂ was washed
with water (80 mL). The water was extracted with CH₂Cl₂
(50 mL) and the combined organic extracts were dried
(MgSO₄) and stripped in vacuo. The residue was
25 crystallized from EtOAc and washed with 40%
EtOAc/hexanes to give the product, (4.8 g, 75%).
NMR(DMSO) δ 9.13 (d, 1H, J=8.8 Hz), 5.9 (s, 1H), 3.92-
4.02 (m, 1H), 3.20-3.25 (m, 2H), 3.28-3.4 (m, 2H), 3.25
(s, 3H), 3.18 (s, 3H), 2.09 (s, 3H), 1.65-1.90 (m, 2H).

30
Part F: (S)-2-Chloro-6-methyl-3-nitro-N-(1-
methoxymethyl-3-methoxypropyl)pyridin-4-amine: 4-
[3-(1,4-dimethoxybutyl)amino]-6-methyl-3-nitropyridone
(4.8 g, 16.82 mmol) was dissolved in POCl₃ (50 mL) and
35 stirred at 25 °C for 40 h. Then the reaction was poured
into ice/water (500 mL), allowed to react, neutralized
with solid NaHCO₃ after EtOAc was added (150 mL) and

extracted with EtOAc (2x300 mL). The EtOAc was dried (MgSO₄) and stripped in vacuo to give the product.
NMR (CDCl₃) δ 7.08 (d, 1H, J=7.7 Hz), 6.65 (s, 1H), 3.85-3.95 (m, 1H), 3.30-3.50 (m, 4H), 3.38 (s, 3H), 3.33 (s, 3H), 2.43 (s, 3H), 1.80-2.02 (m, 2H).

Part G: (S)-3-amino-2-chloro-4-N-(1-methoxymethyl-3-methoxypropyl)-6-methyl-pyridin-4-amine: 2-Chloro-6-methyl-3-nitro-N-(1-methoxymethyl-3-methoxypropyl)pyridin-4-amine (~16.82 mmol) was heated at reflux with Fe powder (10 g) in methanol (120 mL) in the presence of glacial acetic acid (10 mL) for 2 h. Then the iron was filtered through celite, the celite was washed with methanol (80 mL) and the filtrate was stripped in vacuo. The residue was dissolved in 10% HCl (120 mL) and EtOAc was added (160 mL). The mixture was neutralized with solid NaHCO₃ and the aqueous layer was extracted with EtOAc (2x100 mL). The combined organic extracts were washed with brine (50 mL), dried (MgSO₄) and stripped in vacuo (4.1 g).
NMR (CDCl₃) δ 6.4 (s, 1H), 5.2-5.35 (br s, 1H), 3.70-3.80 (m, 1H), 3.2-3.8 (m, 6H), 3.38 (s, 3H), 3.33 (s, 3H), 2.42 (s, 3H), 1.8-2.0 (m, 2H).

Part H: (S)-4-chloro-1-(1-methoxymethyl-3-methoxypropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridine: 3-amino-2-chloro-6-methyl-4-N-(1-methoxymethyl-3-methoxypropyl)pyridin-4-amine (4.1 g, 14.98 mmol) was dissolved in a mixture of CH₂Cl₂ (40 mL) and 50% acetic acid (40 mL) and cooled to 0 °C in an ice bath. To that a solution of NaNO₂ (1.84 g, 26.86 mmol) in water (10 mL) was added dropwise and the reaction was stirred at 0 °C for 30 min and at 25 °C for 1.5 h. Then the acetic acid was neutralized with solid NaHCO₃ and water (80 mL) was added. The mixture was extracted with EtOAc (2x100 mL) and the combined organic extracts were combined and washed with brine (50 mL), dried and

stripped in vacuo. The residue was chromatographed on silica gel (40% EtOAc/hexanes eluent) to give the product (4.05 g, 56% overall for the eight steps).

NMR(CDCl₃) δ 7.25 (s, 1H), 5.04-5.13 (m, 1H), 3.98 (dd,

- 5 1H, $J_1=9.9$ Hz, $J_2=8.4$ Hz), 3.84 (dd, 1H, $J_1=10.2$ Hz, $J_2=4.4$ Hz), 3.39 (dt, 1H, $J_1=9.9$ Hz, $J_2=4.8$ Hz), 3.25 (s, 3H), 3.17 (s, 3H), 2.91 (dt, 1H, $J_1=9.5$ Hz, $J_2=4.0$ Hz), 2.68 (s, 3H), 2.22-2.6 (m, 2H).

- 10 **Part I:** (S)-4-chloro-1-(1-methoxymethyl-3-methoxypropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridine (2.0 g, 7 mmol) and 2-chloro-4,6-dimethylaniline (1.094 g, 7 mmol) were dissolved in dry THF and cooled to 0 °C in an ice bath. To that a 1 M solution sodium
- 15 hexamethyldisilazide (16 mL, 16 mmol) was added dropwise and the solution was stirred at 0 °C for 45 min. Then it was quenched with water (30 mL) and partitioned between EtOAc and water (20 mL). The organic extract was washed with brine (50 mL), dried (MgSO₄) and stripped in vacuo.
- 20 The residue was purified by silica gel chromatography (40% EtOAc/hexanes eluent) and crystallized from hexanes to give the product (2.42 g, 85%), mp 108-109 °C, $[\alpha]_{D25} -32.38$ (c=0.200 g/dL, CHCl₃) 99.6% ee by chiral HPLC. This was converted to the methylsulfonate salt, mp 98-
- 25 100 °C, after crystallization from ether/hexanes, $[\alpha]_{D25} -29.00$ (c=0.200 g/dL, CHCl₃).

Example 414A

- 30 **(R,S)-N-(2-chloro-4,6-dimethylphenyl)-6-methyl-1-(1-methoxymethyl-3-methoxypropyl)-1H-1,2,3-triazolo[4,5-c] pyridin-4-amine**

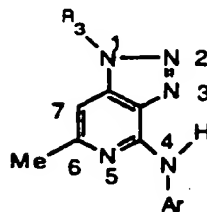
- Part A:** (R,S)-2-Aminobutyrolactone hydrobromide
- 35 (8.0 g, 44 mmol) and triphenylmethyl chloride (12.8 g, 46 mmol) were suspended in dry CH₃CN (80 mL) at 25 °C. To that Et₃N (13.6 mL, 100 mmol) was added dropwise, the

reaction mixture was stirred at 25 °C for 4 h and partitioned between EtOAc (120 mL) and water (50 mL). The organic layer was washed with water (50 mL), brine (50 mL), dried (MgSO₄) and stripped in vacuo. The residue was
5 recrystallized from EtOAc/hexanes to give 2-triphenylmethylamino-butyrolactone (10.5 g).

Part B: Lithium aluminum hydride (1.4 g, 36 mmol) was suspended in dry THF (50 mL) and cooled to 0 °C in an ice bath. To that a solution of 2-
10 triphenylmethylamino-butyrolactone (11 g, 31.9 mmol) in dry THF (70 mL) was added dropwise over a period of 20 min. After the addition was over the reaction mixture was stirred at 0 °C for 1 h, at 25 °C for 3h and quenched by the sequential addition of water (2 mL) 1 N
15 NaOH (2 mL) and water (3 mL), and diluted with ether (150 mL). The precipitated solids were filtered off and the filtrate was concentrated in vacuo to give (R,S)-2-N-triphenylamino-1,4-butanediol. This was used in the same synthetic scheme as previously described for the
20 chiral material (Example 414, Parts C-I) to obtain the racemic material.

The compounds listed in Table 8 were prepared by the methods exemplified in Examples 221-232, 259,
25 414 and 414A.

Table 8
1H-1,2,3-triazolo[4,5-c]pyridines:



Ex. No.	R ³	Ar	m.p. (°C)
415	CH(Et) ₂	4-Br-2,6-(Me) ₂ -Ph	191-192
416	CH(Et) ₂	2,6-(Me) ₂ -4-SMe-Ph	172-173
10 417	CH(Et) ₂	2-Cl-4,6-(Me) ₂ -Ph	171-172
418	CH(Et) ₂	2,4-(Cl) ₂ -6-Me-Ph	164-165
419	CH(Et) ₂	2,4-(Me) ₂ -Ph	90-91
420	CH(Et) ₂	2-Me-4-OMe-Ph	104-105
421	CH(Et) ₂	2-Br-4,6-(Me) ₂ -Ph	178-179
15 422	CH(Et) ₂	4-CN-2,6-(Cl) ₂ -Ph	189-190
423	CH(Et) ₂	3-Br-2,4,6-(Me) ₃ -Ph	156-157
424	CH(Et) ₂	4-Br-2-SMe-Ph	112-114
425	CH(Et) ₂	2-CN-4,6-Me ₂ -Ph	181-183
426	CH(Et) ₂	2-Br-5-F-4-Me-Ph	132-134
20 427	CH(Et) ₂	4-Br-5-F-2-Me-Ph	115-116
428	CH(Et) ₂	2,4-Br ₂ -Ph	164-166
429	CH(Et) ₂	4-Ac-2-SMe-Ph	142-144
430	CH(Et) ₂	4-Br-2-Cl-Ph	152-153
431	CH(Et) ₂	2,4-Cl ₂ -Ph	134-135
25 432	CH(Et) ₂	2,4-Me ₂ -6-SMe-Ph	135-136
433	CH(Et)n-Pr	2,4,6-(Me) ₃ -Ph	117-118
434	CH(Et)CH ₂ OMe	4-Br-2,6-(Me) ₂ -Ph	165-166
435	CH(Et)CH ₂ OMe	2-Cl-4,6-(Me) ₂ -Ph	126-127
436	CH(Et)CH ₂ OMe	3-Br-2,4,6-(Me) ₃ -Ph	117-118
30 437	CH(Et)CH ₂ OMe	2,4-(Cl) ₂ -6-Me-Ph	131-134
438	CH(Et)CH ₂ OMe	2-Br-4,6-(Me) ₂ -Ph	127-128
439	CH(Et)CH ₂ OMe	4-Br-2-Cl-6-Me-Ph	136-137
440	CH(Et)CH ₂ OMe	4-Br-2,6-(Cl) ₂ -Ph	119-120

	441	CH(Et)CH ₂ OMe	2,4-(Me) ₂ -Ph	76-77
	442	CH(Et)CH ₂ OMe	4-MeO-2-Me-Ph	76-77
	443	CH(Et)CH ₂ OMe	2,4,5-(Me) ₃ -Ph	94-95
	444	CH(Et)CH ₂ OMe	2-Cl-4,6-(OMe) ₂ -Ph	167-168
5	445	CH(Et)CH ₂ OMe	2,4,5-(Cl) ₃ -Ph	151-152
	446	CH(Et)CH ₂ OMe	2,5-(Cl) ₂ -4-NO ₂ -Ph	157-158
	447	CH(Et)CH ₂ OMe	2-CN-4,5-(OMe) ₂ -Ph	162-163
	448	CH(Et)CH ₂ OMe	2-Me-4,5-(OMe) ₂ -Ph	118-119
	449	CH(Et)CH ₂ OMe	2,6-Cl ₂ -4-OMe-Ph	136-137
10	450	CH(Et)CH ₂ OCH ₃	4-Br-2-OMe-6-Me-Ph	159-162
	451	CH(Et)CH ₂ OCH ₃	4-Br-5-F-2-Me-Ph	111-113
	452	CH(Et)CH ₂ OCH ₃	2-CN-4,6-Me ₂ -Ph	154-156
	453	CH(Et)CH ₂ OCH ₃	2-OMe-4,6-Me ₂ -Ph	115-116
	454	CH(Et)CH ₂ OCH ₃	2-Ac-4-Cl-6-Me-Ph	127-129
15	455	CH(Et)CH ₂ OCH ₃	2-Br-4,6-F ₂ -Ph	138-140
	456	CH(Et)CH ₂ OCH ₃	2,4,6-Me ₃ -Ph	119-121
	457	CH(Et)CH ₂ OCH ₃	4-Br-2-SMe-Ph	70-73
	458	CH(Et)CH ₂ OCH ₃	2,4-Br ₂ -Ph	119-120
	459	CH(Et)CH ₂ OCH ₃	2,4,6-Me ₃ -Ph	113-115
20	460	CH(Et)CH ₂ OCH ₃	2,4,6-Me ₃ -Ph	113-115
	461	CH(Et)CH ₂ OCH ₃	2,4-Me ₂ -6-SMe-Ph	104-106
	462	CH(Et)CH ₂ OCH ₃	4-Br-2-Me-Ph	amorph.
	463	CH(Et)CH ₂ OCH ₃	4-I-2-Me-Ph	103-105
	464	CH(Et)CH ₂ OCH ₃	3-F-2,4,6-Me ₃ -Ph	amorph.
25	465	CH(Et)CH ₂ OCH ₃	4-Cl-2-Me-Ph	104-105
	466	CH(Et)CH ₂ OCH ₃	4-Br-2,6-F ₂ -Ph	138-140
	467	CH(Et)CH ₂ OCH ₃	4-Cl-2-CN-6-Me-Ph	177-180
	468	CH(CH ₂ OMe) ₂	2,4,6-(Me) ₃ -Ph	115-116
	469	CH(CH ₂ OMe) ₂	4-Br-2,6-(Me) ₂ -Ph	145-146
30	470	CH(CH ₂ OMe) ₂	2,4-(Cl) ₂ -6-Me-Ph	111-112
	471	CH(CH ₂ OMe) ₂	3-Br-2,4,6-(Me) ₃ -Ph	105-106
	472	CH(CH ₂ OMe) ₂	2,4,5-(Me) ₃ -Ph	110-111
	473	CH(CH ₂ OMe) ₂	2-Br-4-CH(Me) ₂ -Ph	107-108
	474	CH(CH ₂ OMe) ₂	2-Br-4,6-(Me) ₂ -Ph	83-84
35	475	CH(CH ₂ OMe) ₂	2,4-(Me) ₂ -Ph	72-73
	476	CH(CH ₂ OMe) ₂	4-MeO-2-Me-Ph	65-67
	477	CH(CH ₂ OMe) ₂	4-CH(Me) ₂ -Ph	oil

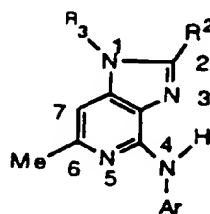
	478	CH(CH ₂ OMe) ₂	2,5-Cl ₂ -4-N(Me) ₂ -Ph	110-111
	479	CH(CH ₂ OMe) ₂	2-Me-4,5-(OMe) ₂ -Ph	111-112
	480	CH(CH ₂ OMe) ₂	4-Cl-2,5-(OMe) ₂ -Ph	167-168
	481	CH(CH ₂ OMe) ₂	2-Cl-4,5-(Me) ₂ -Ph	169-170
5	482	CH(CH ₂ OMe) ₂	2,6-(Cl) ₂ -4-OMe-Ph	145-146
	483	CH(CH ₂ OMe) ₂	4-t-Bu-2,6-(Me) ₂ -Ph	134-135
	484	CH(CH ₂ OMe) ₂	4-Cl-2-Me-5-NO ₂ -Ph	163-164
	485	CH(CH ₂ OMe) ₂	4-Br-2-Cl-5-Me-Ph	159-160
	486	CH(CH ₂ OMe) ₂	2-Cl-4-OMe-6-Me-Ph	117-118
10	487	CH(CH ₂ OMe) ₂	4-Cl-2,5-Me ₂ -Ph	115-116
	488	CH(CH ₂ OMe) ₂	2-Cl-4-CN-6-Me-Ph	127-128
	489	CH(CH ₂ OMe) ₂	4-Br-2,6-(Et) ₂ -Ph	168-169
	490	CH(CH ₂ OMe) ₂	4-Br-2-Cl-6-Me-Ph	104-105
	491	CH(CH ₂ OMe) ₂	2-Cl-4,6-(OMe) ₂ -Ph	139-140
15	492	CH(CH ₂ OMe) ₂	2-Br-4,6-(OMe) ₂ -Ph	155-156
	493	CH(CH ₂ OMe) ₂	5-Cl-4-NMe ₂ -2-OMe-Ph	110-111
	494	CH(CH ₂ OMe) ₂	2,4-(Cl) ₂ -5-CF ₃ -Ph	162-163
	495	CH(CH ₂ OMe) ₂	4-Cl-2-OMe-5-CF ₃ -Ph	161-162
	496	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Cl-2-Et-6-Me-Ph	101-103
20	497	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-F-4,6-Me ₂ -Ph	172-174
	498	CH(CH ₂ OMe)C ₂ H ₄ OMe	2,4-Me ₂ -6-SMe-Ph	147-148
	499	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Br-4,6-Me ₂ -Ph	144-147
	500	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Cl-2,6-Me ₂ -Ph	97-100
	501	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Br-2-Et-6-Me-Ph	111-113
25	502	CH(CH ₂ OMe)C ₂ H ₄ OMe	2,4,6-Me ₃ -Ph	115-116
	503	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Br-2,6-Me ₂ -Ph	amorph.
	504	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Br-2-OMe-6-Me-Ph	131-133
	505	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-4,6-Me ₂ -Ph	127-129
	506	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-I-4,6-Me ₂ -Ph	150-152
30	507	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-4-I-6-Me-Ph	119-120
	508	CH(CH ₂ OMe)C ₂ H ₄ OMe	3-F-2,4,6-Me ₃ -Ph	amorph.
	509	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-4,6-Me ₂ -Ph	127-129
	510	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-4,6-Me ₂ -Ph	108-109
	511	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Br-6-F-4-Me-Ph	150-152
35	512	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-5-F-4,6-Me ₂ -Ph	107-108
	513	CH(CH ₂ OMe)C ₂ H ₄ OMe	3-F-2,4,6-Me ₃ -Ph	117-119
	514	CH(CH ₂ OMe)C ₂ H ₄ OMe	3-F-2,4,6-Me ₃ -Ph	117-119

515	CH(CH ₂ OMe)C ₂ H ₄ OMe	2-Cl-5-F-4,6-Me ₂ -Ph	107-109
516	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Br-2,6-Me ₂ -Ph	-
517	CH(CH ₂ OMe)C ₂ H ₄ OMe	4-Br-2,6-Me ₂ -Ph	amorph.
518	CH(CH ₂ OMe)C ₂ H ₄ OMe	2,4,5-Me ₃ -Ph	oil
519	CH(CH ₂ OMe)C ₂ H ₄ OMe	2,4,5-Me ₃ -Ph	oil
520	CH(CH ₂ OMe)C ₃ H ₆ OMe	2,4,6-Me ₃ -Ph	128-130
521	CH(CH ₂ OMe)C ₃ H ₆ OMe	4-Cl-2,6-Me ₂ -Ph	114-115
522	CH(Bz)CH ₂ OMe	2,4,6-(Me) ₃ -Ph	55-57
523	CH(Bz)CH ₂ OMe	2,4-(Cl) ₂ -6-Me-Ph	64-65

Note: (+), (-), (R) or (S) denotes respective isomers.

The compounds listed in table 9 were prepared by the methods exemplified in Examples 209-211 using the intermediate from example 259, part G.

Table 9
1H-imidazo[4,5-c]pyridines:



Ex. No.	Ar	R ²	R ³	m.p. (°C)
524	2-Cl-4,6-(Me) ₂ -Ph	H	CH(CH ₂ OCH ₃) ₂	129-130
525	2-Cl-4,6-(Me) ₂ -Ph	Me	CH(CH ₂ OCH ₃) ₂	156-157

Example 526

This example illustrates an alternative method for making the compound of Example 32.

5

Part A. (±)-1-Methoxy-2-butanol

Methanesulfonate (1). A solution of 1-methoxy-2-butanol (52.08 g, 57.23 mL, 0.5 mol) and Et₃N (108.2 mL, 0.75 mol, 1.5 equiv) in CH₂Cl₂ (500 mL) was treated
10 dropwise with methanesulfonyl chloride (68.73 g, 46.44 mL, 0.6 mol, 1.2 equiv) at 0 °C under N₂. The reaction mixture was warmed to 25 °C and stirred at 25 °C for an additional 4 h before being quenched with H₂O (300 mL). The two layers were separated, and the aqueous was
15 extracted with CH₂Cl₂ (3 x 100 mL). The combined CH₂Cl₂ extracts were washed with H₂O (2 x 200 mL) and saturated aqueous NaCl (200 mL), dried (MgSO₄), and concentrated in vacuo. The residue was dried enough in vacuo to
20 afforded the desired mesylate 1 (85-90.0 g, 91 g theoretical, 93-98%) as a pale-yellow oil, which was pure enough and directly used in the next reaction without further purification.

The analytically pure sample of 1 was obtained by silicon-gel column chromatography purification and 1 was
25 obtained as a colorless oil.

Part B. (±)-1-Methoxy-2-butyl Azide (2). A solution of crude mesylate 1 (90.0 g, 0.495 mol) in DMF (500 mL) was treated with NaN₃ (48.22g, 0.74 mol, 1.5
30 equiv) at 25 °C under N₂. The resulting reaction mixture was warmed to 55-60 °C for 6-8 h with stirring before being quenched with H₂O (500 mL). The pale-yellow solution was then extracted with EtOAc or Et₂O (4 x 200 mL). The combined EtOAc (or Et₂O) extracts were
35 washed with H₂O (3 x 500 mL), dried (MgSO₄), and concentrated in vacuo. The residual solution was found to contain desired azide 2 (60.3 g, 64.5 g theoretical,

94%), which was found to be pure enough and directly used in the following reaction without further purification.

The analytically pure sample of 2 was obtained by
5 SiO₂ column chromatography purification as a colorless, low boiling-point liquid.

Part C. (±)-4-Amino-5-carbamoyl-1-(1-methoxy-2-)butyl-1H-1,2,3-triazole (3). A suspension of
10 cyanoacetamide (46.5 g, 0.553 mol, 1.2 equiv) in absolute EtOH (200 mL) was treated with EtONa (62.73 g, 0.922 mol, 2.0 equiv) at 25 °C under N₂, and the resulting mixture was warmed to reflux for 15 min under N₂. The cooled mixture was then treated with a solution
15 of 1-methoxy-2-butyl azide 2 (59.5 g, 0.467 mol) in Et₂O and the mixture was diluted with additional EtOH (260 mL) at 25 °C. The resulting reaction mixture was warmed to reflux and stirred for 6-8 h at reflux before being cooled to room temperature. The solvent was removed in
20 vacuo, and the residue was treated with H₂O (300 mL) and EtOAc (300 mL). The two layers were separated, and the aqueous was extracted with EtOAc (5 x 100 mL). The combined EtOAc extracts were washed with saturated aqueous NaCl (50 mL), dried in vacuo, and concentrated
25 in vacuo. The residual yellow solid was directly recrystallized from MeOH (100-150 mL) to afford the desired 1,2,3-triazole 3 (70.7 g, 98.2 g theoretical, 72%) as white crystals.

30 Part D. (±)-9-(1-Methoxy-2-)butyl-2-methyl-8-azaadenine (4). Method A: A solution of 3 (10.65 g, 0.05 mol) in absolute EtOH (50 mL) was treated with EtONa (6.8 g, 0.1 mol, 2.1 equiv) and EtOAc (8.8 g, 10.0 mL, 0.5 mol, 10 equiv) at 25 °C under N₂, and the
35 resulting reaction mixture was warmed to reflux with stirring for 6-8 h before being quenched with H₂O (50 mL). The solution was then concentrated in vacuo to

remove most of EtOH. The residue was treated with H₂O (50 mL), acidified with concentrated HCl (pH 6-7), and extracted with EtOAc (5 x 50 mL). The combined EtOAc extracts were washed with saturated aqueous NaCl (20 mL), dried (MgSO₄), and concentrated in vacuo. The residual pale-yellow solid was directly recrystallized from 80% EtOAc-Hexane or EtOH to afford 8-azaadenine 4 (8.4 g, 11.85 theoretical, 71%) as white crystals.

Method B: A suspension of cyanoacetamide (47.1 g, 0.561 mol, 1.2 equiv) in absolute EtOH (200 mL) was treated with EtONa (95.3 g, 1.4 mol, 3.0 equiv) at 25°C under N₂, and the resulting mixture was warmed to reflux for 15 min. under N₂. The cooled mixture was then treated with a solution of 1-methoxy-2-butyl azide 2 (60.3 g, 0.467 mol) in EtOAc (or Et₂O) in absolute EtOH (170 mL) at 25 °C, and the resulting reaction mixture was warmed to reflux and stirred 4-6 h at reflux before being cooled to RT. EtOAc (120 mL) was added to the reaction mixture, and the resulting mixture was warmed to reflux for an additional 6-10 h. The cooled reaction mixture was treated with H₂O (200 mL), and the solution was concentrated in vacuo to remove most of EtOH. The residue was treated with H₂O (100 mL) and acidified with concentrated HCl (pH 6-7), and extracted with EtOAc (6 x 150 mL). The combined EtOAc extracts were washed with saturated aqueous NaCl (100 mL), dried (MgSO₄), and concentrated in vacuo. The residual pale-yellow solid was recrystallized from 80% EtOAc-Hexane (or EtOH) to afford 8-azaadenine 4 (70.8 g, 110.7 g theoretical, 64% for two steps) as white crystals.

Part E. (±)-4-Chloro-1-(1-methoxy-2-)butyl-2-methyl-8-azaadenine (5). Method A: A solution of 4 (6.78 g, 0.017 mol) in POCl₃ (30 mL) was warmed to reflux for 3 h. The excess POCl₃ was removed in vacuo, and the residue was treated with H₂O (50 mL) and EtOAc (50 mL). The two layers were separated, and the aqueous

was extracted with EtOAc (3 x 50 mL). The combined EtOAc extracts were washed with H₂O (2 x 50 mL) and saturated aqueous NaCl (30 mL), dried (MgSO₄), and concentrated in vacuo. Flash chromatography (SiO₂, 10-20% EtOAc-Hexane gradient elution) afforded 5 (6.65 g, 7.30 g theoretical, 91%) as a colorless oil, which solidified upon standing in vacuo.

Method B: A solution of 4 (170 mg, 0.72 mmol) was treated with POCl₃ (2 mL) and *N,N*-diethylaniline (0.5 mL) at 25 °C under N₂, and the resulting mixture was warmed to reflux for 4-6 h. The excess POCl₃ was removed in vacuo, and the residue was directly purified by flash chromatography (SiO₂, 10-20% EtOAc-Hexane gradient elution) to afford 5 (159 mg, 184 mg theoretical, 86%) as a colorless oil, which solidified in vacuo. The product obtained by Method B was identical in all comparable respects with that obtained from Method A.

Part P. (±)-1-(1-Methoxy-2-)butyl-2-methyl-4-[(2,4,6-trimethyl)phenyl]amino-8-azaadenine (6).

A solution of 5 (7.0 g, 0.0274 mol) in toluene (50 mL) was treated with 2,4,6-trimethylphenyl amine (8.1 g, 0.06 mol, 2.2 equiv) at 25 °C under N₂. The resulting reaction mixture was warmed to reflux for 6-8 h under N₂. The white solid (2,4,6-trimethylaniline HCl salt) was filtered and the solid was washed with toluene (10-20 mL). The filtrate was concentrated in vacuo. The residual pale-yellow solid was recrystallized from 30% EtOAc-Hexane to afford the title compound 6 (7.9 g, 9.7 g theoretical, 81%) as white crystals.

UtilityCRF-R1 Receptor Binding Assay for the Evaluation of
Biological Activity

5

The following is a description of the isolation of cell membranes containing cloned human CRF-R1 receptors for use in the standard binding assay as well as a description of the assay itself.

10 Messenger RNA was isolated from human hippocampus. The mRNA was reverse transcribed using oligo (dt) 12-18 and the coding region was amplified by PCR from start to stop codons. The resulting PCR fragment was cloned into the EcoRV site of pGEMV, from whence the insert was
15 reclaimed using XhoI + XbaI and cloned into the XhoI + XbaI sites of vector pm3ar (which contains a CMV promoter, the SV40 't' splice and early poly A signals, an Epstein-Barr viral origin of replication, and a hygromycin selectable marker). The resulting expression
20 vector, called phchCRFR was transfected in 293EBNA cells and cells retaining the episome were selected in the presence of 400 μ M hygromycin. Cells surviving 4 weeks of selection in hygromycin were pooled, adapted to growth in suspension and used to generate membranes for
25 the binding assay described below. Individual aliquots containing approximately 1×10^8 of the suspended cells were then centrifuged to form a pellet and frozen.

For the binding assay a frozen pellet described above containing 293EBNA cells transfected with hCRFR1
30 receptors is homogenized in 10 ml of ice cold tissue buffer (50 mM HEPES buffer pH 7.0, containing 10 mM $MgCl_2$, 2 mM EGTA, 1 μ g/l aprotinin, 1 μ g/ml leupeptin and 1 μ g/ml pepstatin). The homogenate is centrifuged at 40,000 x g for 12 min and the resulting pellet
35 rehomogenized in 10 ml of tissue buffer. After another centrifugation at 40,000 x g for 12 min, the pellet is

resuspended to a protein concentration of 360 µg/ml to be used in the assay.

Binding assays are performed in 96 well plates; each well having a 300 µl capacity. To each well is
5 added 50 µl of test drug dilutions (final concentration of drugs range from 10^{-10} - 10^{-5} M), 100 µl of ^{125}I -ovine-CRF (^{125}I -o-CRF) (final concentration 150 pM) and 150 µl of the cell homogenate described above. Plates
10 are then allowed to incubate at room temperature for 2 hours before filtering the incubate over GF/F filters (presoaked with 0.3% polyethyleneimine) using an appropriate cell harvester. Filters are rinsed 2 times with ice cold assay buffer before removing individual
15 filters and assessing them for radioactivity on a gamma counter.

Curves of the inhibition of ^{125}I -o-CRF binding to cell membranes at various dilutions of test drug are analyzed by the iterative curve fitting program LIGAND (P.J. Munson and D. Rodbard, *Anal. Biochem.* 107:220
20 (1980), which provides K_i values for inhibition which are then used to assess biological activity.

A compound is considered to be active if it has a K_i value of less than about 10000 nM for the inhibition of CRF.

25

Inhibition of CRF-Stimulated Adenylate Cyclase Activity

Inhibition of CRF-stimulated adenylate cyclase activity was performed as described by G. Battaglia
30 et al. *Synapse* 1:572 (1987). Briefly, assays were carried out at 37° C for 10 min in 200 µl of buffer containing 100 mM Tris-HCl (pH 7.4 at 37° C), 10 mM MgCl_2 , 0.4 mM EGTA, 0.1% BSA, 1 mM isobutylmethylxanthine (IBMX), 250 units/ml
35 phosphocreatine kinase, 5 mM creatine phosphate, 100 mM guanosine 5'-triphosphate, 100 nM oCRF, antagonist peptides (concentration range 10^{-9} to 10^{-6}M) and 0.8

mg original wet weight tissue (approximately 40-60 mg protein). Reactions were initiated by the addition of 1 mM ATP/³²P]ATP (approximately 2-4 mCi/tube) and terminated by the addition of 100 ml of 50 mM Tris-HCL, 45 mM ATP and 2% sodium dodecyl sulfate. In order to monitor the recovery of cAMP, 1 µl of [³H]cAMP (approximately 40,000 dpm) was added to each tube prior to separation. The separation of [³²P]cAMP from [³²P]ATP was performed by sequential elution over Dowex and alumina columns. Recovery was consistently greater than 80%.

Some compounds of this invention were tested in this assay and found to be active.

15 In vivo Biological Assay

The *in vivo* activity of the compounds of the present invention can be assessed using any one of the biological assays available and accepted within the art. Illustrative of these tests include the Acoustic Startle Assay, the Stair Climbing Test, and the Chronic Administration Assay. These and other models useful for the testing of compounds of the present invention have been outlined in C.W. Berridge and A.J. Dunn *Brain Research Reviews* 15:71 (1990)

25 Compounds may be tested in any species of rodent or small mammal. Disclosure of the assays herein is not intended to limit the enablement of the invention.

30 Compounds of this invention have utility in the treatment of imbalances associated with abnormal levels of corticotropin releasing factor in patients suffering from depression, affective disorders, and/or anxiety.

35 Compounds of this invention can be administered to treat these abnormalities by means that produce contact of the active agent with the agent's site of action in the body of a mammal. The compounds can be

administered by any conventional means available for use in conjunction with pharmaceuticals either as individual therapeutic agent or in combination of therapeutic agents. They can be administered alone,
5 but will generally be administered with a pharmaceutical carrier selected on the basis of the chosen route of administration and standard pharmaceutical practice.

The dosage administered will vary depending on
10 the use and known factors such as pharmacodynamic character of the particular agent, and its mode and route of administration; the recipient's age, weight, and health; nature and extent of symptoms; kind of concurrent treatment; frequency of treatment; and
15 desired effect. For use in the treatment of said diseases or conditions, the compounds of this invention can be orally administered daily at a dosage of the active ingredient of 0.002 to 200 mg/kg of body weight. Ordinarily, a dose of 0.01 to 10
20 mg/kg in divided doses one to four times a day, or in sustained release formulation will be effective in obtaining the desired pharmacological effect.

Dosage forms (compositions) suitable for administration contain from about 1 mg to about 100
25 mg of active ingredient per unit. In these pharmaceutical compositions, the active ingredient will ordinarily be present in an amount of about 0.5 to 95% by weight based on the total weight of the composition.

30 The active ingredient can be administered orally is solid dosage forms, such as capsules, tablets and powders; or in liquid forms such as elixirs, syrups, and/or suspensions. The compounds of this invention can also be administered parenterally in sterile
35 liquid dose formulations.

Gelatin capsules can be used to contain the active ingredient and a suitable carrier such as but

not limited to lactose, starch, magnesium stearate, steric acid, or cellulose derivatives. Similar diluents can be used to make compressed tablets. Both tablets and capsules can be manufactured as sustained release products to provide for continuous release of medication over a period of time. Compressed tablets can be sugar-coated or film-coated to mask any unpleasant taste, or used to protect the active ingredients from the atmosphere, or to allow selective disintegration of the tablet in the gastrointestinal tract.

Liquid dose forms for oral administration can contain coloring or flavoring agents to increase patient acceptance.

In general, water, pharmaceutically acceptable oils, saline, aqueous dextrose (glucose), and related sugar solutions and glycols, such as propylene glycol or polyethylene glycol, are suitable carriers for parenteral solutions. Solutions for parenteral administration preferably contain a water soluble salt of the active ingredient, suitable stabilizing agents, and if necessary, buffer substances. Antioxidizing agents, such as sodium bisulfite, sodium sulfite, or ascorbic acid, either alone or in combination, are suitable stabilizing agents. Also used are citric acid and its salts, and EDTA. In addition, parenteral solutions can contain preservatives such as benzalkonium chloride, methyl- or propyl-paraben, and chlorobutanol.

Suitable pharmaceutical carriers are described in "Remington's Pharmaceutical Sciences", A. Osol, a standard reference in the field.

Useful pharmaceutical dosage-forms for administration of the compounds of this invention can be illustrated as follows:

Capsules

A large number of units capsules are prepared by filling standard two-piece hard gelatin capsules
5 each with 100 mg of powdered active ingredient, 150 mg lactose, 50 mg cellulose, and 6 mg magnesium stearate.

Soft Gelatin Capsules

10 A mixture of active ingredient in a digestible oil such as soybean, cottonseed oil, or olive oil is prepared and injected by means of a positive displacement was pumped into gelatin to form soft
15 gelatin capsules containing 100 mg of the active ingredient. The capsules were washed and dried.

Tablets

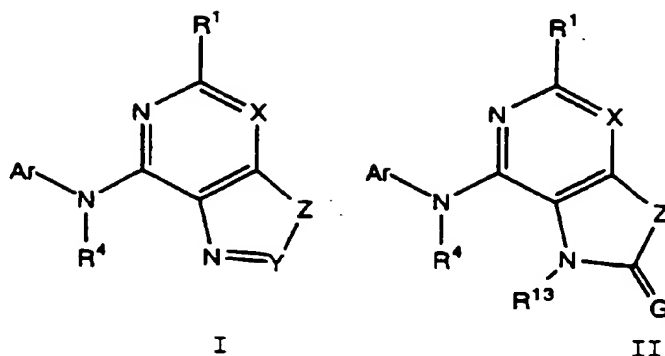
A large number of tablets are prepared by conventional procedures so that the dosage unit was
20 100 mg active ingredient, 0.2 mg of colloidal silicon dioxide, 5 mg of magnesium stearate, 275 mg of microcrystalline cellulose, 11 mg of starch, and 98.8 mg lactose. Appropriate coatings may be applied to increase palatability or delayed adsorption.
25

The compounds of this invention may also be used as reagents or standards in the biochemical study of neurological function, dysfunction, and disease.

Claims:

5

1. A CRF antagonist compound of formula I or formula II:



10

or a pharmaceutically acceptable salt or pro-drug form thereof, wherein:

X is N or CR¹;

15

Y is N or CR²;

Z is NR³, O, or S(O)_n;

20

G is O or S;

Ar is phenyl, naphthyl, pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl or pyrazolyl, each optionally substituted with 1 to 5 R⁵ groups;

25

R¹ is independently at each occurrence H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;

30

- R^2 is H, C₁-C₄ alkyl, C₁-C₆ cycloalkyl, halo, CN, -NR⁶R⁷, NR⁹COR¹⁰, C₁-C₄ haloalkyl, -OR⁷, SH or -S(O)_nR¹²;
- 5 R^3 is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, -CONR⁶R⁷, aryl, heteroaryl and heterocyclyl, where the aryl, heteroaryl or heterocyclyl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- 10 15 20 R^4 is H, C₁-C₄ alkyl, allyl, or propargyl, where C₁-C₄ alkyl, allyl, or propargyl is optionally substituted with C₃-C₆ cycloalkyl and where C₁-C₄ alkyl is optionally substituted with, -OR⁷, -S(O)_nR¹² or -CO₂R⁷;
- 25 30 R^5 is independently at each occurrence C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo, -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷, -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or -S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-C₁₂ cycloalkylalkyl are optionally substituted
- 35

with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, -NO₂, halo, -CN, -NR⁶R⁷, -NR⁶R⁷, NR⁹COR⁷, NR⁸CO₂R⁷, -COR⁷, -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;

5 R⁶ and R⁷ are independently at each occurrence H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or
10 heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is piperidine, pyrrolidine, piperazine, N-methylpiperazine, morpholine or thiomorpholine;

R⁸ is independently at each occurrence H or C₁-C₄
15 alkyl;

R⁹ and R¹⁰ are independently at each occurrence selected from H, C₁-C₄ alkyl, or C₃-C₆ cycloalkyl;

20 R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

25 R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

30 aryl is phenyl or naphthyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
35 -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

- heteroaryl is pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl, tetrazolyl, or indazolyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- heterocyclyl is saturated or partially saturated heteroaryl, optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- n is independently at each occurrence 0, 1 or 2;
- provided that R⁴ in formula I is not H:
- (a) when X is N, Y is N, Z is NR³, R¹ is H, R³ is H or benzyl, and Ar is p-methylphenyl;
 - (b) when X is N, Y is N, Z is NR³, R¹ is butyl, R³ is benzyl, and Ar is phenyl;
 - (c) when X is N, Y is CH, Z is NR³, R³ is methyl, R¹ is H, and Ar is phenyl or 2-fluorophenyl;
 - (d) when X is N, Y is CH, Z is NR³, R³ is methyl, R¹ is Cl and Ar is phenyl;
 - (e) when X is N, Y is CH, Z is NR³, R¹ is Cl, R³ is benzyl, and Ar is phenyl or substituted phenyl;

- (f) when X is N, Y is CH, Z is NR³, R³ is p-methylbenzyl, and Ar is phenyl;
- (g) when X is N, Y is CR², Z is NR³, R² is CH₃, R³ is H, and Ar is phenyl or phenyl substituted with methyl, ethyl, isopropyl, fluoro or chloro;
- (h) when X is N, Y is N, Z is NR³, R³ is cyclopropylmethyl, R¹ is H, and Ar is 2-bromo-4-isopropylphenyl, or
- (i) when X is N, Y is N, Z is S, R¹ is H, and Ar is 2-bromo-4-isopropylphenyl.

2. A CRF antagonist compound of claim 1 or a pharmaceutically acceptable salt or pro-drug form thereof, wherein:

- X is N or CR¹;
- Y is N or CR²;
- Z is NR³, O, or S(O)_n;
- G is O or S;
- Ar is phenyl, pyridyl, each optionally substituted with 1 to 3 R⁵ groups;
- R¹ is independently at each occurrence H, C₁-C₄ alkyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, -OR¹¹ or -S(O)_nR¹²;
- R² is H, C₁-C₄ alkyl, C₁-C₆ cycloalkyl, halo, CN, -NR⁶R⁷, NR⁹COR¹⁰, C₁-C₄ haloalkyl, -OR⁷ or -S(O)_nR¹²;
- R³ is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents

- independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, -S(O)_nR¹³, -CO₂R⁷, -NR⁸COR⁷, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, aryl and
- 5 heteroaryl, where the aryl or heteroaryl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, halo, cyano, -OR⁷, -S(O)_nR⁷, -CO₂R⁷, -NR⁸COR⁷, -NR⁸CONR⁶R⁷, -NR⁸CO₂R⁷, and -NR⁶R⁷;
- 10 R⁴ is H, C₁-C₄ alkyl, allyl, or propargyl;
- R⁵ is independently at each occurrence C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl,
- 15 C₄-C₈ cycloalkylalkyl, -NO₂, halo, -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, COR⁷ -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or -S(O)_nR⁷, where C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl and C₄-C₁₂ cycloalkylalkyl are optionally substituted
- 20 with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, -NO₂, halo, -CN, -NR⁶R⁷, COR⁷, -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;
- 25 R⁶ and R⁷ are independently at each occurrence H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is piperidine, pyrrolidine,
- 30 piperazine, N-methylpiperazine, morpholine or thiomorpholine;
- R⁸ is independently at each occurrence H or C₁-C₄ alkyl;
- 35 R⁹ and R¹⁰ are independently at each occurrence selected from H, C₁-C₄ alkyl, or C₃-C₆ cycloalkyl;

R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

R¹³ C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

aryl is phenyl or naphthyl optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, halo, cyano, -OR⁷, -S(O)_nR¹², -CO₂R⁸, -NR⁸COR⁷, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹², and -NR⁶R⁷;

heteroaryl is pyridyl, pyrimidinyl, triazinyl, furanyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, isoxazolyl, pyrazolyl, triazolyl, tetrazolyl, or indazolyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, halo, cyano, -OR⁷, -S(O)_nR¹², -CO₂R⁸, -NR⁸COR⁷, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹², and -NR⁶R⁷;

n is independently at each occurrence 0, 1 or 2.

3. A CRF antagonist compound of claim 1 selected from the group consisting of:

N-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-3-propyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

N-[2-bromo-4-(1methylethyl)phenyl]-N-ethyl-5-methyl-3-propyl-3H - 1,2,3-triazolo[4,5-d]pyrimidin-7-amine

- N-[2-bromo-4-(1-methylethyl)phenyl]-3-butyl-N-ethyl-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5 N-[2-bromo-4-(1-methylethyl)phenyl]-3-(cyclopropylmethyl)-N-ethyl-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 10 N-[2-bromo-4-(1-methyl)ethylphenyl]-5-methyl-3-[(1-methoxymethyl)-2-methoxyethyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 15 N-[2-bromo-4-(1-methylethyl)phenyl]-3-(2-methoxyethyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 20 N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-3-(2-methoxyethyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 25 (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 30 (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- (S)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-[1-(1-methoxymethyl)-2-phenylethyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 35 (S)-methyl 7-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-2-(methylthio)ethyl-3H-1,2,3-triazolo[4,5-d]pyrimidine-3-acetate

- (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-1-ethylpentyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5
- (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-3-(1-ethylpentyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 10
- N-[2-bromo-4-(1-methylethyl)phenyl]-3-(1-propylbutyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- N-[2-bromo-4-(1-methylethyl)phenyl]-3-(1-butylpentyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 15
- (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-3-(1-ethylbutyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 20
- (+/-)-7-[2-bromo-4-(1-methylethyl)phenyl]-5-methyl-3-propyl-3H-1,2,3-triazolo[4,5-d]pyrimidine-3-ethanol
- N-[2-bromo-4-(1-methylethyl)phenyl]-3-(1-ethylpropyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 25
- N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-3-(1-ethylpropyl)-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 30
- N-(2-bromo-4,6-dimethylphenyl)-5-methyl-3-(1-propylbutyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5-methyl-N-[4-(1-methylethyl-2-(methylthio)phenyl)-3-(1-propylbutyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 35
- N-[2-bromo-4-(trifluoromethyl)phenyl]-5-methyl-3-(1-propylbutyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

- N-(2-bromo-4,6-(dimethoxy)phenyl)-5-methyl-3-[1-propylbutyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5 N-(2,6-dimethyl-4-(methylthio)phenyl)-5-methyl-3-[1-propylbutyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- N-(4-acetyl-2-bromophenyl)-3-[1-ethylpropyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 10 (+/-)-N-(4acetyl-2-bromophenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 15 (+/-)-N-(4-bromo-2,6-dimethylphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- (+/-)-N-(2,6-dimethyl-4-(methylthio)phenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 20 (+/-)-N-(2-bromo-4,6-dimethoxyphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 25 (+/-)-N-(2-chloro-4,6-dimethoxyphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 30 (+/-)-3-[1-(1-methoxymethyl)propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 35 (+/-)-N-ethyl-3-[1-(1-methoxy-methyl)propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

- 3-[1-(1-ethyl)propyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5 (+/-)-3-[1-(1-ethyl)butyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 10 (+/-)-3-[1-(1-ethyl)pentyl]-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidine-7-amine
- 5-methyl-3-[1-(1-propylbutyl)-N-(2,4,6-trimethylphenyl)]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 15 3-(2-methoxyethyl)-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 20 N-ethyl-3-(2-methoxyethyl)-5-methyl-N-(2,4,6-trimethylphenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- N-(2-Methyl-4-bromophenyl)-3-[1-(1-propyl)butyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 25 (+/-)-3-[1-(1-ethyl)butyl]-5-methyl-N-(2-methyl-4-bromophenyl)-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 30 (+/-)-N-(4-bromo-2-methylphenyl)-3-[1-(1-methoxymethyl)propyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- (+/-)-3-[1-(1-ethyl)pentyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 35

- (+/-)-N-ethyl-3-[1-(1-ethyl) pentyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 5 (+/-)-3-[1-(1-ethyl) butyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 10 N-ethyl-3-[1-(1-ethyl) butyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amin
- 15 3-[1-(1-propyl) butyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- N-ethyl-3-[1-(1-propyl) butyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 20 (+/-)-3-[1-(1-methoxymethyl) propyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 25 (+/-)-N-ethyl-3-[1-(1-methoxy methyl) propyl]-5-methyl-N-(2,4,6-trimethyl)-3-pyridyl]-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 30 N-2,4-dibromophenyl)-5-methyl-3-(1-propyl) butyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- N-[4-acetyl-2-bromphenyl]-5-methyl-3-(1-propyl) butyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine
- 35 N-[2-bromo-4-(1-methylethyl) phenyl]-3-[1-(N,N-dimethylamino-methyl) butyl]-5-methyl-3H-1,2,3-triazolo[4,5-d]pyrimidin-7-amine

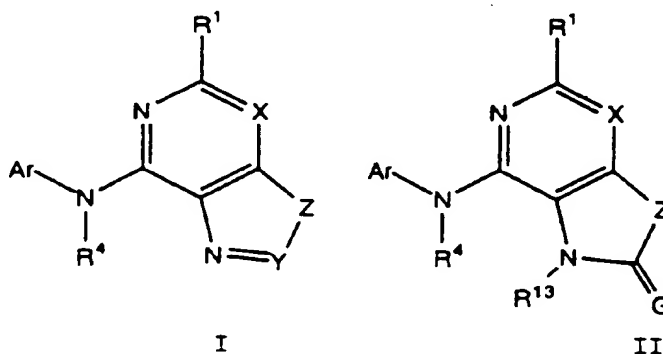
- N-[2-bromo-4-(1-methylethyl)phenyl]-2-methyl-9-(1-propylbutyl)-9H-purin-6-amine
- (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-9-(1-ethylpentyl)-2-methyl-9H-purin-6-amine
- 5 (+/-)-N-[2-bromo-4-(trifluoromethyl)phenyl]-9-1-(methoxymethyl)propyl]-2-methyl-9H-purin-6-amine
- 10 N-[2-bromo-4-(1-methylethyl)phenyl]-N-ethyl-5-methyl-[1,2,3]thiadiazolo[5,4-d]pyrimidin-7-amine
- N-[2-bromo-4-(1-methylethyl)phenyl]-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 15 N-(2-bromo-4,6-dimethoxyphenyl)-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- N-(2-chloro-4,6-dimethoxyphenyl)-1-(1-ethylpropyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 20 N-(2-bromo-4,6-dimethoxyphenyl)-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 25 N-(2-chloro-4,6-dimethoxyphenyl)-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- (+/-)-N-[2-bromo-4-(1-methylethyl)phenyl]-1-(1-ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 30 (+/-)-N-(2-bromo-4,6-dimethoxyphenyl)-1-(1ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 35 (+/-)-N-(2-chloro-4,6-dimethoxyphenyl)-1-(1-ethylpentyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine

- N-[2-bromo-4-(1-methylethyl)phenyl]-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 5 N-[4-(1-methylethyl)-2-sulfonylmethylphenyl]-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- N-[4-(4-acetyl-2-bromophenyl)-6-methyl-1-(1-propylbutyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 10 N-(2-chloro-4,6-dimethylphenyl)-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 15 Mesylate salt of N-(2-chloro-4,6-dimethylphenyl)-1-[1-methoxymethyl-(2-methoxyethyl)-6-methyl-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 6-[N-(2-chloro-4,6-dimethylphenyl)]-9-[(1-methoxymethyl)propyl]-2-methyl-9H-purin-6,8-diamine
- 20 (S)-(-)-N-(2-chloro-4,6-dimethylphenyl)-6-methyl-1-(1-methoxymethyl-3-methoxypropyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine
- 25 (R,S)-N-(2-chloro-4,6-dimethylphenyl)-6-methyl-1-(1-methoxymethyl-3-methoxypropyl)-1H-1,2,3-triazolo[4,5-c]pyridin-4-amine.
- 30 4. A pharmaceutical composition comprising a pharmaceutically acceptable carrier and a therapeutically effective amount of a compound of claim 1.
- 35 5. A pharmaceutical composition comprising a pharmaceutically acceptable carrier and a

therapeutically effective amount of a compound of claim 2.

6. A pharmaceutical composition comprising a
5 pharmaceutically acceptable carrier and a
therapeutically effective amount of a compound of claim 3.

7. A method of treating affective disorder, anxiety,
10 depression, irritable bowel syndrome, post-traumatic
stress disorder, supranuclear palsy, immune
suppression, Alzheimer's disease, gastrointestinal
disease, anorexia nervosa or other feeding disorder,
drug or alcohol withdrawal symptoms, drug addiction,
15 inflammatory disorder, or fertility problem in a
mammal comprising administering to the mammal a
therapeutically effective amount of a CRF antagonist
compound of formula I or II:



or a pharmaceutically acceptable salt or pro-drug
form thereof, wherein:

25 X is N or CR¹;

Y is N or CR²;

30 Z is NR³, O, or S(O)_n;

G is O or S;

Ar is phenyl, naphthyl, pyridyl, pyrimidinyl,

5 triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl or pyrazolyl, each optionally substituted with 1 to 5 R⁵ groups;

10

R¹ is independently at each occurrence H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;

15

R² is H, C₁-C₄ alkyl, C₁-C₆ cycloalkyl, halo, CN, -NR⁶R⁷, NR⁹COR¹⁰, C₁-C₄ haloalkyl, -OR⁷, SH or -S(O)_nR¹²;

20

R³ is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl,

25

C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, -CONR⁶R⁷, aryl, heteroaryl and

30

heterocyclyl, where the aryl, heteroaryl or heterocyclyl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷,

35

-N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

- R^4 is H, C₁-C₄ alkyl, allyl, or propargyl, where C₁-C₄ alkyl, allyl, or propargyl is optionally substituted with C₃-C₆ cycloalkyl and where C₁-C₄ alkyl is optionally substituted with,
5 -OR⁷, -S(O)_nR¹² or -CO₂R⁷;
- R^5 is independently at each occurrence C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo,
10 -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷ -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or -S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-C₁₂ cycloalkylalkyl are optionally substituted
15 with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, -NO₂, halo, -CN, -NR⁶R⁷, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷ -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;
- 20 R^6 and R^7 are independently at each occurrence H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is
25 piperidine, pyrrolidine, piperazine, N-methylpiperazine, morpholine or thiomorpholine;
- R^8 is independently at each occurrence H or C₁-C₄ alkyl;
30
- R^9 and R^{10} are independently at each occurrence selected from H, C₁-C₄ alkyl, or C₃-C₆ cycloalkyl;
- 35 R^{11} is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈
alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-
5 C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-,
heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

aryl is phenyl or naphthyl, each optionally
substituted with 1 to 3 substituents
10 independently selected at each occurrence from
C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
-NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

15 heteroaryl is pyridyl, pyrimidinyl, triazinyl,
furanyl, quinolinyl, isoquinolinyl, thienyl,
imidazolyl, thiazolyl, indolyl, pyrrolyl,
oxazolyl, benzofuranyl, benzothienyl,
20 benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl,
tetrazolyl, or indazolyl, each optionally
substituted with 1 to 3 substituents
independently selected at each occurrence from
C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
25 C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
-NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

heterocyclyl is saturated or partially saturated
30 heteroaryl, optionally substituted with 1 to 3
substituents independently selected at each
occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl,
halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH,
-S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷,
35 -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and
-CONR⁶R⁷;

n is independently at each occurrence 0, 1 or 2;

provided that R⁴ in formula I is not H:

(a) when X is N, Y is N, Z is NR³, R³ is
5 cyclopropylmethyl, R¹ is H, and Ar is 2-bromo-4-
isopropylphenyl, or

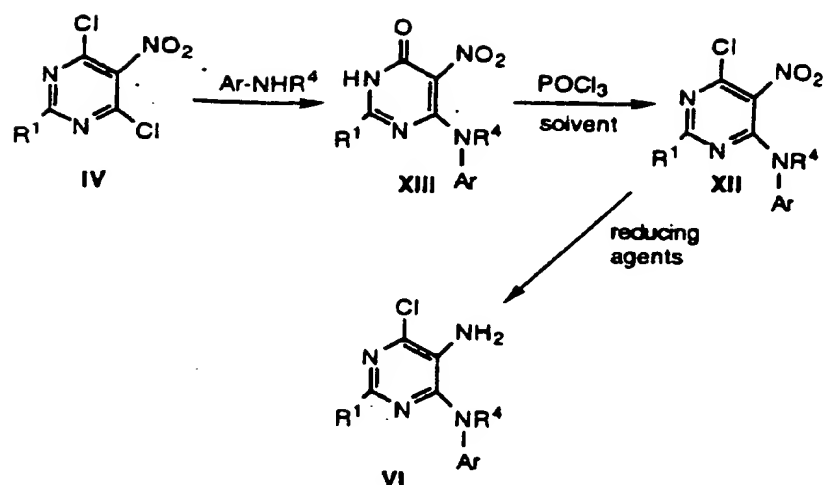
(b) when X is N, Y is N, Z is S, R¹ is H, and Ar
is 2-bromo-4-isopropylphenyl.

10

8. A method of treating an affective disorder,
anxiety, or depression in a mammal comprising
administering to the mammal a therapeutically
effective amount of a CRF antagonist compound of
15 claim 2.

9. A method of treating an affective disorder,
anxiety, or depression in a mammal comprising
administering to the mammal a therapeutically
20 effective amount of a CRF antagonist compound of
claim 3.

10. A process for making a 5-amino-4-chloro-6-
arylamino-2-substituted pyrimidine of formula VI which
25 comprises reacting a 4,6-dichloro-5-nitro-2-substituted
pyrimidine of formula IV with an arylamine of formula
ArNHR⁴ in the presence of a solvent selected from
dialkylsulfoxides, dialkylformamides and alkyl alcohols
to produce a pyrimidone of formula XIII, reacting the
30 pyrimidone with phosphorous oxychloride to produce a 4-
chloro-6-arylamino-5-nitro-2-substituted pyrimidine of
formula XII, then treating the pyrimidine of formula XII
with a reducing agent, as shown in the following scheme:



wherein

- 5 Ar is phenyl, naphthyl, pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl or pyrazolyl, each
 10 optionally substituted with 1 to 5 R⁵ groups;
- R¹ is H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰,
 15 -OR¹¹, SH or -S(O)_nR¹²;
- R⁴ is H, C₁-C₄ alkyl, allyl, or propargyl, where
 C₁-C₄ alkyl, allyl, or propargyl is optionally
 substituted with C₃-C₆ cycloalkyl and where
 C₁-C₄ alkyl is optionally substituted with,
 20 -OR⁷, -S(O)_nR¹² or -CO₂R⁷;
- R⁵ is independently at each occurrence C₁-C₁₀ alkyl,
 C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆
 cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo,
 25 -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷,
 -COR⁷ -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or

-S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-C₁₂ cycloalkylalkyl are optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₄ alkyl, -NO₂, halo, -CN, -NR⁶R⁷, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷, -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;

R⁶ and R⁷ are independently at each occurrence H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is piperidine, pyrrolidine, piperazine, N-methylpiperazine, morpholine or thiomorpholine;

R⁸ is independently at each occurrence H or C₁-C₄ alkyl;

R⁹ and R¹⁰ are independently at each occurrence selected from H, C₁-C₄ alkyl, or C₃-C₆ cycloalkyl;

R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

aryl is phenyl or naphthyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-

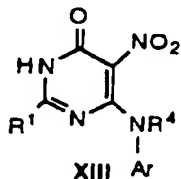
C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
 -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
 -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

- 5 heteroaryl is pyridyl, pyrimidinyl, triazinyl,
 furanyl, quinolinyl, isoquinolinyl, thienyl,
 imidazolyl, thiazolyl, indolyl, pyrrolyl,
 oxazolyl, benzofuranyl, benzothienyl,
 benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl,
 10 tetrazolyl, or indazolyl, each optionally
 substituted with 1 to 3 substituents
 independently selected at each occurrence from
 C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
 C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
 15 -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
 -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

n is independently at each occurrence 0, 1 or 2.

20

11. A pyrimidone of formula XIII



25 wherein

- Ar is phenyl, naphthyl, pyridyl, pyrimidinyl,
 triazinyl, furanyl, quinolinyl, isoquinolinyl,
 thienyl, imidazolyl, thiazolyl, indolyl,
 30 pyrrolyl, oxazolyl, benzofuranyl, benzothienyl,
 benzthiazolyl, isoxazolyl or pyrazolyl, each
 optionally substituted with 1 to 5 R⁵ groups;

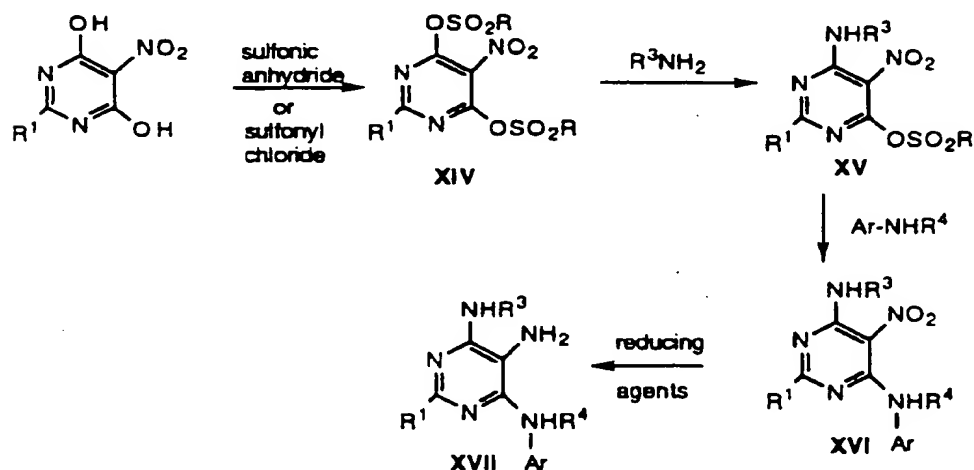
- R^1 is H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;
- 5 R^4 is H, C₁-C₄ alkyl, allyl, or propargyl, where C₁-C₄ alkyl, allyl, or propargyl is optionally substituted with C₃-C₆ cycloalkyl and where C₁-C₄ alkyl is optionally substituted with, -OR⁷, -S(O)_nR¹² or -CO₂R⁷;
- 10 R^5 is independently at each occurrence C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo, -CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷,
15 -COR⁷ -OR⁷, -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or -S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-C₁₂ cycloalkylalkyl are optionally substituted with 1 to 3 substituents independently selected
20 at each occurrence from C₁-C₄ alkyl, -NO₂, halo, -CN, -NR⁶R⁷, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷ -OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;
- R^6 and R^7 are independently at each occurrence H,
25 C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is piperidine, pyrrolidine, piperazine, N-methylpiperazine, morpholine or thiomorpholine;
30
- R^8 is independently at each occurrence H or C₁-C₄ alkyl;
- 35 R^9 and R^{10} are independently at each occurrence selected from H, C₁-C₄ alkyl, or C₃-C₆ cycloalkyl;

- R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or C₃-C₆ cycloalkyl;
- 5 R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;
- R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-, heteroaryl or heteroaryl(C₁-C₄ alkyl)-;
- 10 aryl is phenyl or naphthyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- 15 heteroaryl is pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl, tetrazolyl, or indazolyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- 20 25 30 n is independently at each occurrence 0, 1 or 2;
- 35 provided that: when Ar is phenyl substituted with 2 or 3 substituents selected from C₁-C₄ alkyl, chloro and bromo, or pyridyl substituted with 2 or 3

substituents selected from C₁-C₄ alkyl, chloro and bromo; and R₁ is methyl or ethyl; then R₄ is not H or methyl.

5

12. A method of making a compound of formula XVII by reacting a 4,6-dihydroxy-5-nitropyrimidine with an aryl sulfonic anhydride, aryl sulfonyl chloride, alkyl sulfonic anhydride or alkyl sulfonyl chloride to produce a compound of formula XIV, reacting the latter compound with an amine of the formula R³NH₂ to produce a compound of formula XV, reacting the latter compound with an arylamine of the formula ArNHR⁴ to produce a compound of formula XVI, then treating the latter compound with a reducing agent, as shown in the following scheme:



20 wherein

Ar is phenyl, naphthyl, pyridyl, pyrimidinyl, triazinyl, furanyl, quinoliny, isoquinoliny, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl, oxazolyl, benzofuranyl, benzothienyl,

25

benzthiazolyl, isoxazolyl or pyrazolyl, each optionally substituted with 1 to 5 R⁵ groups;

5 R is the hydrocarbon residue of the aryl or alkyl sulfonic anhydride or sulfonyl chloride;

R¹ is H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;

10

R³ is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, -CONR⁶R⁷, aryl, heteroaryl and heterocyclyl, where the aryl, heteroaryl or heterocyclyl is optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

15

20

25

R⁴ is H, C₁-C₄ alkyl, allyl, or propargyl, where C₁-C₄ alkyl, allyl, or propargyl is optionally substituted with C₃-C₆ cycloalkyl and where C₁-C₄ alkyl is optionally substituted with, -OR⁷, -S(O)_nR¹² or -CO₂R⁷;

30

35 R⁵ is independently at each occurrence C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, -NO₂, halo,

-CN, C₁-C₄ haloalkyl, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷,
-COR⁷ -OR⁷; -CONR⁶R⁷, -CO(NOR⁹)R⁷, CO₂R⁷, or
-S(O)_nR⁷, where C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl,
C₂-C₁₀ alkynyl, C₃-C₆ cycloalkyl and C₄-
5 C₁₂ cycloalkylalkyl are optionally substituted
with 1 to 3 substituents independently selected
at each occurrence from C₁-C₄ alkyl, -NO₂, halo,
-CN, -NR⁶R⁷, -NR⁶R⁷, NR⁸COR⁷, NR⁸CO₂R⁷, -COR⁷
-OR⁷, -CONR⁶R⁷, CO₂R⁷, -CO(NOR⁹)R⁷, or -S(O)_nR⁷;

10

R⁶ and R⁷ are independently at each occurrence H,
C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl,
C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl,
aryl(C₁-C₄ alkyl)-, heteroaryl or
15 heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is
piperidine, pyrrolidine, piperazine, N-
methylpiperazine, morpholine or thiomorpholine;

R⁸ is independently at each occurrence H or C₁-C₄
20 alkyl;

R⁹ and R¹⁰ are independently at each occurrence
selected from H, C₁-C₄ alkyl, or C₃-C₆
cycloalkyl;

25

R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or
C₃-C₆ cycloalkyl;

R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

30

R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈
alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-
C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-,
heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

35

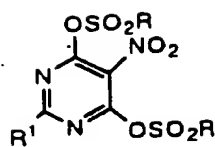
alkyl in alkyl sulfonic anhydrides and alkyl sulfonyl
chlorides is C₁-C₄ branched or straight chain

alkyl optionally substituted with 1 to 3 fluorines;.

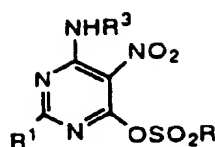
- 5 aryl is phenyl or naphthyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
10 -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- heteroaryl is pyridyl, pyrimidinyl, triazinyl, furanyl, quinolinyl, isoquinolinyl, thienyl, imidazolyl, thiazolyl, indolyl, pyrrolyl,
15 oxazolyl, benzofuranyl, benzothienyl, benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl, tetrazolyl, or indazolyl, each optionally substituted with 1 to 3 substituents independently selected at each occurrence from
20 C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;
- 25 heterocyclyl is saturated or partially saturated heteroaryl, optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH,
30 -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

35 n is independently at each occurrence 0, 1 or 2.

13. A compound of formula XIV or XV:



XIV



XV

wherein:

5

R is aryl as defined below or is C₁-C₄ branched or straight chain alkyl optionally substituted with 1 to 3 fluorines;

10 R¹ is H, C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, halo, CN, C₁-C₄ haloalkyl, -NR⁹R¹⁰, NR⁹COR¹⁰, -OR¹¹, SH or -S(O)_nR¹²;

15 R³ is H, C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl, C₂-C₁₀ alkynyl, C₃-C₈ cycloalkyl or C₄-C₁₂ cycloalkylalkyl each optionally substituted with 1 to 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano,
20 -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, -CONR⁶R⁷, aryl, heteroaryl and heterocyclyl, where the aryl, heteroaryl or heterocyclyl is optionally substituted with 1 to
25 3 substituents independently selected at each occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and
30 -CONR⁶R⁷;

R⁶ and R⁷ are independently at each occurrence H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈ alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-C₁₂ cycloalkylalkyl, aryl,

aryl(C₁-C₄ alkyl)-, heteroaryl or
heteroaryl(C₁-C₄ alkyl)-; or NR⁶R⁷ is
piperidine, pyrrolidine, piperazine, N-
methylpiperazine, morpholine or thiomorpholine;

5 R⁸ is independently at each occurrence H or C₁-C₄
alkyl;

10 R⁹ and R¹⁰ are independently at each occurrence
selected from H, C₁-C₄ alkyl, or C₃-C₆
cycloalkyl;

R¹¹ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, or
C₃-C₆ cycloalkyl;

15 R¹² is C₁-C₄ alkyl or C₁-C₄ haloalkyl;

20 R¹³ is C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₈
alkoxyalkyl, C₃-C₆ cycloalkyl, C₄-
C₁₂ cycloalkylalkyl, aryl, aryl(C₁-C₄ alkyl)-,
heteroaryl or heteroaryl(C₁-C₄ alkyl)-;

25 aryl is phenyl or naphthyl, each optionally
substituted with 1 to 3 substituents
independently selected at each occurrence from
C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
-NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

30 heteroaryl is pyridyl, pyrimidinyl, triazinyl,
furanyl, quinolinyl, isoquinolinyl, thienyl,
imidazolyl, thiazolyl, indolyl, pyrrolyl,
oxazolyl, benzofuranyl, benzothienyl,
35 benzthiazolyl, isoxazolyl, pyrazolyl, triazolyl,
tetrazolyl, or indazolyl, each optionally
substituted with 1 to 3 substituents

independently selected at each occurrence from
C₁-C₆ alkyl, C₃-C₆ cycloalkyl, halo, C₁-
C₄ haloalkyl, cyano, -OR⁷, SH, -S(O)_nR¹³, -COR⁷,
-CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷, -N(COR⁷)₂,
5 -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and -CONR⁶R⁷;

heterocyclyl is saturated or partially saturated
heteroaryl, optionally substituted with 1 to 3
substituents independently selected at each
10 occurrence from C₁-C₆ alkyl, C₃-C₆ cycloalkyl,
halo, C₁-C₄ haloalkyl, cyano, -OR⁷, SH,
-S(O)_nR¹³, -COR⁷, -CO₂R⁷, -OC(O)R¹³, -NR⁸COR⁷,
-N(COR⁷)₂, -NR⁸CONR⁶R⁷, -NR⁸CO₂R¹³, -NR⁶R⁷, and
-CONR⁶R⁷;

15

n is independently at each occurrence 0, 1 or 2.

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